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NOTICE

HENRY WILLIAM MACROSTY
Elected President June 18th 1940
Died January 19th, 1941

(A biographical notice will be found on page 85 of this issue)

JOURNAL

OF THE ROYAL STATISTICAL SOCIETY

PART I, 1941.

ECONOMIC STATISTICS—RETROSPECT AND PROSPECT

THE INAUGURAL ADDRESS OF THE PRESIDENT,
HENRY W. MACROSTY, O.B.E., B.A.*

HAD not a wicked man presented the world with the alternatives of submitting to his domination in cowardice or by force, I should scarcely be addressing the Society, for, according to recent custom, 1940 would be a year for the election of an " external " President. From 1834 to 1869 the list of the names of our Presidents reads like a page of Debrett; they distinctly belonged to the " Best People." Newmarch definitely broke down this tradition, and for a long time our Presidents were generally men who had distinguished themselves in statistical work. About the beginning of this century the custom grew of alternating an " internal " with an " external " President, one who would keep us in touch with the great world outside our walls. This year that has not been possible, so here I am. I have never called myself any kind of " -ist " or " -ician," I have written no text-books, I have invented no theories, I have constructed no formulæ. My work has mainly been teamwork and is buried, or enshrined, in blue-books or in memoranda that have been pulped long ago. I have been just a humble worker, engaged in collecting and arranging economic facts and figures, and, as far as for me was possible, in interpreting them. I bring you some years of faithful service to the Society and the assurance that I shall continue to serve while I can. But I cannot vacate the Honorary Secretaryship which I have held for twelve years without acknowledging the tolerant consideration shown to me by my colleagues and the loyal co-operation given by Miss Thorburn and the rest of the staff.

The last Annual Report has explained how, in war conditions, we have had to modify our practices and habits. Since war broke out things have indeed been hard for our Office, which has been understaffed and overworked, and on their behalf I would beg of you to be patient when the publication of the *Journal* is delayed.

* Owing to war conditions, it was reluctantly decided not to hold the November Meeting of the Society. The Inaugural Address of the President is therefore printed without having been orally delivered, and the comments which follow were furnished in writing.

We are fortunate in starting the new Session with no serious loss of membership, and though our costs of operation have gone up, I see no reason why we should not weather this storm as we did the last.

Two losses must be referred to briefly. J. A. Hobson was a Fellow for 36 years, and it would not be becoming to pass by the death in April, 1940, of so famous a rebel against orthodox economic views. As Maynard Keynes, who always has a kindly heart for heretics, says, the publication of *The Physiology of Industry* by Hobson and Mummery in 1889 " marks, in a sense, an epoch in economic thought." Hobson was always an inspiration to us when we were young, even when we did not entirely agree with him. Henry Higgs was a Fellow since 1892, an economist and bibliographer rather than a statistician. Neither of those two men took an active part in the Society, but they were types of Fellows who supported the Society's work because they thought it was good. We cannot do without such men.

I wonder if the students of statistics to-day ever realize how lucky they are, when full provision is made for them at more than one centre and they can choose from an abundant supply of admirable text-books—not always as cheap as they may desire. Their only real danger is that they may come to think that formulæ are more important than facts. When I began it was worse than at Dotheboys Hall, for we had to clean our " winder " first and then learn how to spell it. I came to London in October, 1884, as a member of Her Majesty's Civil Service with the honorific title of " Man Clerk of the Lower Division," a despised body which has since gone through various exaltations and is now, I believe, known as the Executive Class. Though the present Head of the Civil Service began his career in that class when it was known as the Second Division and I am now content to bask in reflected glory, the memory of my detestation alike for the title and the job and of my frantic and, for many years, futile efforts to escape from the prison-house is still with me. As I had not only to live on £80 a year but to save on it, you can believe that there was not much money for classes on subjects other than those which might be expected to " pay " in an examination. But there was always the Educational Library at South Kensington, and there I read hard at economics and biology. I had already, as a boy, read Mrs. Fawcett's *Political Economy for Beginners*, and have since always kept a strong preference for the old title over " Economics." Somewhere, too, I have an old notebook with records of inherited genius, compiled in imitation of Galton's immortal work. So there, I suppose, were implanted in me the germs of statistics and economics ! Anyhow, I read assiduously everything I could lay my hands on, from Senior to Sidgwick.

Intelligent people—really intelligent people, the " intelligentsia " had not then invented itself—in the world outside my Office were, meantime, astir, and I suppose that my first real introduction to statistics came through the Fabian Society. *Facts for Socialists*, Fabian Tract No. 5 (1887), by Sidney Webb, has since grown from 16 to 46 pages, and instead of Tract No. 8, *Facts for Londoners* (1889), we have now the voluminous publications of the London County Council. " Say not, the struggle nought availeth ! " I wonder, by the way, if those who frequent the London School of Economics know that they owe the foundation of that institution to two bequests to the Fabian Society for social research. There were Royal Commissions on Housing, Agriculture, and Labour, and they all served to show how scanty was the supply of necessary statistics. The Agricultural Reports contain in the surveys by some of the Commissioners, especially those by Mr. Wilson Fox, afterwards of the Board of Trade, models of enquiries. The evidence given before the Labour Commission is now mainly of interest as providing psychological studies of the principal protagonists in the debates across the witness-table, but its outcome was the establishment of the Labour Department of the Board of Trade in 1893. The public interest in the condition of the people was now lively, Charles Booth was at work, and things were on the march. My own interests at that time lay mainly in labour conditions and, a little later, in the study of the trust movement, and could not, with truth, be described as statistical. But study of the official enquiry into the depression of 1886 and of the bimetallist agitation served as some preparation for expounding trade statistics while taking part in the Free-Trade-Protection campaign of 1903–4. Again, one was driven to the conviction that the available statistics were insufficient and confused, and much digging into trade journals and the like was needed before one could determine their real significance.

The main importance of the Protection debate, so far as I was concerned, was the passing of the Census of Production Act, 1906, and the establishment of the Census of Production Office in 1907. I do not know if the Director, Mr. D. F. Schloss, had had any statistical training or not, but in any case he went on sick leave in a couple of months and did not return. I was left in charge, with some occasional supervision, and I certainly was no trained statistician. Even my self-taught mathematics were very rusty, and when I tried to " swot " up the Differential Calculus again, I got so interested in the " story " that I could not wait to work up the examples, and so that was not much good. But some of my colleagues were transferred from the Labour Department, and others had served under Charles Booth, and between us we worked out methods which have stood the test of

time and of investigation by the International Statistical Institute.
In the infrequent intervals of waiting for papers I read textbooks,
and I remember being amused to find that a method I had devised for
testing the probable accuracy of returns was in essence a graph of
frequencies. I had not thought it was anything particular. The fact
is that we just applied common-sense to our job, and common-sense
is more important in statistics than many of the proficients will
admit. Another little thing may amuse you. When Mr. (now Sir
Alfred) Flux was appointed Director of the Census of Production in
1911, I took to him the Final General Report and said : " I've written
this thing out four times and it's all right, but it isn't a Report.
What am I to do ? " He said : " Try standing it on its head."
I did. I put the second half first, and it was a Report, and after that
we wrangled over every page of it, every paragraph, every sentence,
till we were agreed on everything, even the mistakes. I have often
wished since that the Council would allow me to incorporate in the
" Notes for Readers of Papers " that wise advice.

The Great War brought fresh experiences in the use of statistics
of shipping, of cargoes, and of production, for the important purpose
of ascertaining available and forthcoming supplies for the troops.
Lecky in his *Rationalism in Europe* quotes a law of Diocletian.
" Ars autem mathematica damnabilis et interdicta omnino "—" the
mathematic art is damnable and utterly forbidden." The " mathe-
matic art " was the art of foretelling the future by the use of numbers,
and appears to be closely allied to the art of " forecasting," much
practised in the United States. However that may be, my war work
taught me very thoroughly the risks of forecasting. After the war
up to 1930, when I had to retire, Mr. Flux and I worked on the
statistics for which the Board of Trade were responsible. What we
did and what Mr. Leak has done in extension thereof is, or ought to
be, familiar to you all, and I shall not dilate on it. Here I leave my
personal reminiscences of statistics.

What of the future of economic statistics ? Much has been done
in the past fifty years, but much more remains to be done. We
have still no Quinquennial Census : we know little about the dis-
tribution of incomes assessed for income tax except in the topmost
range; we have no reliable figures of working-class earnings and
expenditure; calculations of the National Income and of Savings
require much estimation; we have no census of distribution; the
monetary and other suggestions of the Macmillan Report (Cmd. 3897
of 1931, pars. 405–424) have not all been adopted, though nine years
have passed. Those statistics are of the most intimate importance
for the determination of public policy. For example, Sir John Orr
in *Food, Health and Income* surveys the adequacy of diet in relation

to income. Dividing the population into six income groups, he has to estimate the population in each group, and also the average expenditure on food in each group. As is carefully explained, and as generally forgotten by the reader, nearly all the calculations are based on insufficient data. The picture may be all right as a rough sketch, but it is nothing more. Again, when Mr. Keynes proposes a system of compulsory saving and of lending to the State, it is highly important to be sure of the incidence of the burden on different income groups. He " accepts Colin Clark's statistics, but not his concept of gross national income, without attempting to go behind them or to criticize them." That is all very well if statistics are only meant to decorate an argument, and I greatly approve Mr. Clark's assiduity and his public spirit in collecting at his own expense particulars relating to the incomes of different classes. But I turn to the *Economic Journal* for 1938, and there I find in an article by Mr. Clark on page 444 a table in which he shows *quarter by quarter* from 1929 to 1937 figures, precise to the last million pounds, for such categories as, *inter alia*, " Balance of Payments," " Total Investment," " Total Private Consumption," " Gross National Income." I simply don't believe it. This table is a strong argument for proper official enquiries. Meanwhile, unfortunately, we shall have to put aside Mr. Keynes's inspired guesses and find other reasons for coming to a decision on his proposals.

The past 50 or 60 years which I have surveyed show a steady progress in the collection of statistics, but there is still a considerable resentment at the so-called " useless curiosity" or " nose-poking habits" of Government Departments. Yet statistics are only the numerical record of facts, and are indispensable both for administration and for the framing of policy. Population statistics probably had a military basis, but in modern times their motive is the laudable desire of a Government to ascertain by one particular test the condition of a nation. From this proceed statistics of births, marriages, and deaths, so that progress or its reverse may be measured. Mortality statistics govern a whole series of health measures, and statistics relating to children lead to the framing of educational policies. And recently the fear of a declining population has led to the collection of new particulars bearing on fertility. Statistics of imports and exports arise as an administrative by-product from the records of duties, subsidies, etc., and from the " mercantile" desire to find whether there is or is not a " favourable" balance of trade. Such records are found to be useful to merchants and producers and are expanded. Their movement affects policy, and when it is alleged that external trade is declining while the population is growing, resort is had, as we have seen in our own time, to the compulsory collection

of statistics of production in order to find the truth about total trade. Collection of prices, so as to isolate quantity movements from value movements, follows, so, too, do estimates of the " balance of payments," and other estimates—all of which may not directly affect administration, but do provide the advocates and opponents of particular policies with powder and shot. To the extent, therefore, to which their basis is insecure they are very dangerous. Policy can only be sound if it is founded on a reliable ascertainment of all the facts. One further example. Statistics of unemployment were at first kept and published by individual trade unions as necessary records of their expenditure on out-of-work benefit. These were then collected by the Board of Trade and converted into index-numbers as a measure of the state of employment and industry at different periods. Though confessedly incomplete, they gave an indication of the amount of misery arising from lack of work, and, as the public conscience became keener, they led to the National Insurance Act of 1911 and its successors. These Acts produced fresh and more complete statistics, which in their turn have called for new policies.

Policy, administration, and statistics are thus inextricably interwoven, and records which were at first the by-products of administration become, when properly digested, the sources of new policies and new forms of administration. The farther we get away from the do-nothing-ism of *laissez-faire* which Carlyle denounced with such fuliginous fury in *Latter Day Pamphlets* 90 years ago, the more is this conclusion true. Society is never static, our theories must explain and conform to changes which appear to be spontaneously generated, and our records must keep step with the changes. How strange it is to hear people talk, forgetting the experiences of 1919–31, of " getting back to normal " after the war ! The one thing certain is that there will be no normal to get back to. When the war is won and a satisfactory settlement made, the troubles of peace will begin. After a preliminary re-stocking boom there will be at once a great dislocation of employment, and much devaluation of capital goods through the cessation of war industries. There will be an immense burden of debt, and the power of private consumption will be reduced at the very moment when it will be necessary to get the people back to peace-employment. External trade will have been not only reduced, but diverted from its former channels. The problems of the maintenance of agriculture and shipping will present themselves forcibly. Lastly—though the list of problems is far from exhausted —questions of the distribution of the national income and of the raising of the position of those below or only slightly above the poverty line will be put forward by a great political party.

What is the scheme of things to which we may look forward and

to which we shall have to accommodate ourselves and our theories?
It would be arrant folly to attempt any precise prediction, but a
consideration of what happened after 1919 may help.   Then private
enterprise achieved a return to peace-time conditions with an im-
mense waste of men and material.   Competition failed to eliminate
incompetent firms and to reward the efficient, for as long as it could
meet its prior charges, an inefficient firm or company could continue
in existence and disorganize a whole industry.   Everywhere there
was a welter of disorderly competition in home industries, made
worse by the competition of foreign industries which had suffered less
from war conditions.   A universal appeal for Government assistance
followed, first for protection of home industries against foreign com-
petition, and, secondly, for the compulsion of recalcitrant minorities
to make them conform to the policies of the majorities.   Those
appeals for the organization of industries as wholes were in each case
spontaneous from within, not induced from outside, and, if there is
any meaning in the terms " natural " and " artificial," it was as
" natural " a development as the passage from home industry to
factory industry during the industrial revolution.

During the past ten years, agriculture, fishery, shipping, road
transport, iron and steel, coal, and even that once irrefragably in-
dividualistic industry, cotton, have adopted some form of self-regula-
tion and accepted some measure of State control.   Broadly speaking
the aim has been to maintain prices at a level which would secure a
fair livelihood to all sections of producers without imposing an undue
burden on consumers.   These two aims may turn out to be incom-
patible, and provision will have to be made for safeguarding the
public.   Two forms of governance have been tried—one, government
of the industry solely by representatives of the industry, as in the
case of milk and coal, with an appeal to an arbitrator in cases of
alleged hardship, and the other, of which iron and steel are the
cardinal example, where price changes and alterations in other im-
portant matters of trade policy can only be made after the assent of
an independent body appointed by the Government is secured.   Of
these two methods the latter is the one to be preferred, if only because
it is better to prevent the causes of complaints than to remedy the
abuses or defects which are the subject of appeal.   How far it will be
possible to maintain or extend these forms of organization in the
conditions which will exist when this war is over we cannot now say,
but it may be noted that the iron and steel industry not only ob-
served moderation in prosperity, but easily weathered the mild re-
cession of 1938.   The engineering industry, general and electrical,
presents one of the greatest problems.   Will it wish to articulate its
several branches into a vertebrate whole, or will it choose to rely on

a number of private rings forming and dissolving in different branches, and, if it prefers the latter, will that be to the public interest?

It is obvious that a vast array of statistics will be required not only to determine whether there shall be a change in organization and to enable the Government to find out whether anything is being done contrary to the public interest, but also for the purposes of administration. Closely organized industries—like milk, coal, iron and steel —at once proceed to collect and publish masses of statistics; they collect them for their own purposes and issue them to show the public that all is well. If the principle to be adopted for sanctioning price changes is that they should follow alterations in costs, it is plain that particulars relating to wages and cost of raw materials must be provided and, further, that the situation of individual firms or classes of firms must be examined to ensure that only the costs of efficient units are taken as a basis.

Again, if only because it is better to cultivate our own garden rather than abandon it to weeds and briars, a strong claim will be made that farmers must be secured a decent livelihood, and what that is cannot be discovered by the light of nature but only after painful enquiry. Shipping, too, we are warned, will need help after the war to repair its losses and to ensure its capacity to compete, and it is quite certain that whatever Government Department is dealing with the question will require, if not every year, at least periodically, particulars of shipowners' business at least as detailed and as difficult as those used by Dr. Isserlis in his paper in December, 1937, which caused much moaning.

There will be thus no lack of work for the compilers of economic statistics, whether in private or in public employ, and certainly a sufficiency of home problems for those who have to interpret the statistics, even if we consider only the proximate changes that must come. I am not here thinking of the ultimate form of organization of industry. I do not believe in ultimate forms, but the information collected by the statistician and published at judicious periods in judicious detail will help to guide in the transition from one change to another.

Our sphere of operation will not, however, be limited to the United Kingdom, for Mr. Chamberlain, speaking for his Government, announced that after the war, in pursuance of the policy of building up a new Europe, there would have to be a closer co-operation among the nations, first and most particularly between this country and France in continuance of the economic unity established for war purposes, and, secondly, with such other countries as desired to come in. The United States Government has also proclaimed that it could only regard as a satisfactory peace settlement one which

provided for a considerable relaxation of the restraints which at present impede the free movement of goods. These aims are admitted by all to be desirable, but they are not to be attained by wishful thinking or the utterance of slogans. The substitution of orderly for disorderly marketing in international trade implies an agreement as to the sharing of markets between different countries and arrangements for the maintenance of complementary industries in different parts of the world. We shall certainly come into conflict with the ambitions of various States to progress in industrial development, heedless of the effects on other States, and no arrangement concerning exports and imports has ever been made which did not run counter to the interests of particular groups of manufacturers and traders. It has also to be remembered that import duties can be an important weapon for the State regulation of industry; the iron and steel industry was forced to organize itself into an integrated whole by the warning that fiscal protection might be withdrawn, and the Continental Steel Cartel was only induced to concede a fair share of overseas markets to the British industry by the temporary imposition of a penal import duty. No trade policy has any chance of success which is not founded on the most careful study and understanding of the facts. The economic section of the League of Nations has already provided us with useful comparative studies of the course of international trade in the last 20 years, but I do not think that these have penetrated far beyond the study and the lecture-room. Much has yet to be done to spread the knowledge of the developments of international trade and their causes and meaning—"meaning" including their quantitative importance as well as their qualitative significance. I wonder, too, if we have exhausted the methods of statistical analysis of trade data, or whether it is possible that something more of importance might be learned by the application of some of the methods of modern mathematical research. Perhaps our Industrial and Agricultural Research Section and the Study Group might look into this.

There is another sphere of action to which I would direct your attention—the study of the cost of living in relation to the incomes of different classes of society. Whatever dispute there may be as to numbers, it is agreed that too large a proportion of the population is not in a position to obtain sufficient sustenance. At the same time it seems clear that if the policy of developing home agriculture is to be continued and a reasonable livelihood is to be secured to all classes of agriculturists, food prices will be more than the poor can pay. There are two ways in which a remedy may be sought. One is to impose by law a minimum wage sufficient to raise incomes above the poverty line and to secure for all the minimum ration of food, cloth-

ing, and shelter as scientifically determined; if the fear of declining population is justified, family allowances may have to be granted. The other way is that adopted by our Government as a war measure, to subsidize out of taxation the production or importation of essential foods—wheat, milk, meat, etc.—so as to keep prices within the reach of the poor without sweating the producers. The exploration of those methods will require much analysis of existing data and much field-work to provide new information. During the last war the poorest classes received increases of income which brought them comforts they had never dreamed of, and they retained a large part of their gains. The public conscience has grown more awake since then, and the " condition-of-the-people question " is once more open for debate. It is certain that in the future nutrition must form the basis of policy, even of international trade, and the repercussions of different lines of policy on each other must be carefully watched. Despite the researches of the last few years we have still much to learn, and in the collection and study of what is as yet unknown, as well as of what is at present known, statisticians are needed for the service of the future.

" The objects of the Royal Statistical Society are to collect, arrange, digest and publish facts, illustrating the condition and prospects of society in its material, social and moral relations; these facts being for the most part arranged in tabular forms and in accordance with the principles of the numerical method." So runs Bye-Law 1, in direct descent from the Prospectus of the Statistical Society of London issued on April 23rd, 1834. Such facts were to be collected for the use of other enquirers—" *aliis exterendum*," to be threshed out by others, but that restriction and the repudiation, to use Lord Overstone's words, of " the use of theoretical views, by which the imagination might be excited and the interest stimulated " (*Annals of the Royal Statistical Society*, page 82), were long ago found to be impossible. To-day I am bold enough to affirm that due preparation for the future of society requires the union of the functions of economist and statistician. As I have already said, economic changes originate not in the study, but in the market-place, not in pursuance of some theory, but under the impact of forces spontaneously arising. Much of the apparatus of the modern economist will have to be given up—principles of human nature, closed systems, frictionless transactions, *et hoc genus omne*. A distinguished economist has said, in what I hope was a moment of inattention, " When the *a priori* yields nothing, it may be well to revert to observed facts." I propose to reverse the procedure ! A great deal of mathematical apparatus will also have to be left aside, and I would remind you that Marshall, himself no mean mathematician, has said that " it seems doubtful whether anyone spends his time well in reading

lengthy translations of economic doctrines into mathematics, that have not been made by himself " (*Principles of Economics* : preface). Such renunciations will bring a return to the clarity of the classical economists. However much we may now see that their views were conditioned by the economic structure of society in their time, we can still read them and profit by them, but with many a modern writer I am left wondering whether, like Andrew Pringle in *The Ayrshire Legatees*, he " deals in the diplomatics of obscurity."

My economist-statistician will find that his first occupation will be research work, the supplementing of what is past and known with what is unknown and becoming. He will tabulate and arrange the data which are already collected, he will point out the importance of filling up the gaps in our knowledge, and will demand powers to secure all necessary information. Where knowledge is defective he will be cautious about sampling, very shy about interpolating and extrapolating, and altogether doubtful about forecasting. Indeed, he will, no doubt with regret, discover that many of the finer weapons of mathematical statistics are unsuited for the coarser work of his field investigations. But tables of statistics, as a noble predecessor, the Earl of Harrowby, observed in his Presidential Address in 1851, by themselves " will very often lead to false conclusions " (*op. cit.*, page 81). The men whose activities are recorded in the figures will be able to furnish what, to them, are sufficient explanations, but these will require to be collated and analysed. Nor must any series of facts be considered by itself ; every economic development springs from something pre-existing, and so we are brought to study history in order to discover the lines of economic ontology. Three great departments of economics have been in the past regarded as separate and almost as hostile—theory, statistics, and history—and must now be united in order to provide temporary generalisations explanatory of the present. Such explanations will not only display harmonies, but expose disharmonies and will thus open the way to changes of policy intended to produce a better future. Contrary to a popular definition of economics, my economist-statistician will concern himself not only with what is, but with what ought to be. All his work—again to use the words of Lord Overstone, though with an extension of meaning that would probably have horrified his lordship—will be " accumulated under some systematic arrangement and for some definite and beneficial purpose."

Do not think that I am painting too idealist a picture, or that I am setting out a task which cannot be overtaken. As Paul said, " There are diversities of gifts, but the same Spirit." Some will prefer to devote themselves to the collection, arrangement, and explanation of facts, others will delve into the past in order to discover the

origins of the present, others will make general syntheses of the data, and others will use the work of these groups of colleagues in order to frame new policies. But all will be animated by the same desire, to plan the New Jerusalem. You are the master-builders of the future, for this task I bid you equip yourselves, to this labour I call upon you to sally forth.

<div align="center">DISCUSSION ON MR. MACROSTY'S PAPER</div>

PROFESSOR A. L. BOWLEY : It is my final privilege, as ex-President, to thank the existing President for his Inaugural Address, and in normal times I should have been expressing the sentiments of an appreciative audience. The Address contains an interesting personal account of a "Man Clerk of the Lower Division" who found that he had a President's gavel in his knapsack. It naturally does not tell us that it is largely through his unremitting work as Honorary Secretary and otherwise that the traditions and efficiency of the Society have been preserved; while Presidents and Councillors come and go, the permanent officers are there to advise or to guide them, and all of us who have served the Society during his long term of office have realized how essential have been Mr. Macrosty's knowledge and how vigorous and pertinent his advice. Nor shall we forget that he compiled the history of the Society and of the Dinner Club at the times of their centenaries.

When we look back over the more than half a century since Mr. Macrosty began his Civil Service career, we can recall the considerable additions to current knowledge made by the Board of Trade and its offspring, the Ministry of Labour, and I can realize that much information has become available that I have searched for in vain when I first attempted statistical enquiry. Impetus was given by the Fiscal Controversy of 1902–4, by the need of statistics in the Great War, by the tariff laws of more recent date. But on the whole the record is disappointing. Besides the gaps to which Mr. Macrosty alludes, we have had no Wage Census that shows more detail than average earnings since 1886. The Censuses of Production leave the Net Output to be divided as best we can into Rent, Rates, Profits, Wages, etc. Owing to the existing statistical "black-out," we have no general collection of working-class budgets published since 1904. The Population Census does not contain any tabulation of households that might enable us to consider families in other aspects than a number of persons in a number of rooms.

Will the Society after this war be able to get access to part of the great mass of information that is now pouring into the various Ministries and is kept secret by them, so that outside students of affairs may in retrospect know what has happened? Perhaps the many members who are now in the Ministries might be asked to file these semi-secret documents and ultimately bring them to light when there is no enemy to guard against. Strong efforts may be needed to break down the Censorship of statistics.

Though Mr. Macrosty warns us to be " altogether doubtful about

forecasting," perhaps he will not object to an anticipation. After the war employers, and even Local Authorities, may rebel, not only against detailed control of their affairs, but also against the multiplication of blank forms which they are required to fill in. *Circa* 1916 a manufacturer reported to the Ministry of Munitions that he could produce either completed questionnaires or shells, but not both. Our economist-statistician may have to proceed not by sampling, interpolation, or extrapolation, but by pure guesswork. The remedy for this possible condition may be found in the rationalization of national statistics; by this I understand a Central Bureau, so often advocated in vain, where it should be determined what facts should be ascertained for efficient administration and adequate sociological knowledge, and should collect them in the manner least inconvenient to the informants, communicate them to the administrative departments, and publish them without delay in a form both intelligible and accurate. If this was done, it is possible that the well-founded objection to the multiplication of inquisitive enquiries might gradually be removed.

I do not know whether our President would approve of this suggestion, or whether, as a good Board of Trade man, he thinks departmentally. At any rate it seems to me to be a natural rider to his very stimulating address.

PROFESSOR GREENWOOD : A writer well loved by our President said of a predecessor :—

> Ille velut fidis arcana sodalibus olim
> Credebat libris, neque si male cesserat usquam
> Decurrens alio, neque si bene; quo fit ut omnis
> Votiva pateat veluti descripta tabella
> Vita senis . . .

Physicans used to say that a man was as old as his arteries, and a song-writer implied that one's heart was a criterion. By either test our President is excluded from the class *senex*, but he is in mere years an older man than Lucilius lived to be, and I do not think the Roman *could* have made a more vivid picture of his life. This too-brief story of a life of faithful service to truth, with its expression of a faith in the time to come, has given at least one honorary vice-president a pleasant interlude in the drama which so often seems to justify Macbeth's summary of life.

For those of us whose share in present events is that of a spectator, it is well to review the past, and the President's account of the evolution of official statistics is heartening. It may be true that the public—whether politicians, officials or private citizens—have been terribly slow to learn and profit from the lessons taught by the statistical facts, and that, too often, official statistics have been and are being used to support opinions bred of wishful thinking. But these melancholy truths do not hurt the consciences of our Fellows. We at least have striven to learn and enforce the conclusions which official statistics justify. We have been grateful to officials—if a cynic likes to say that was easy because so many of us have been

officials, I will not deny it—and have welcomed the comments and criticisms of private investigators. A Fellow of the Society who used the hours of darkness to read through the file of our *Journal* covering the last thirty years would have a sense of intellectual progress. I think I have read somewhere that there was never a dark age in mathematics; never, that is, a period when progress wholly ceased, as it did in experimental science and medicine. In statistical science progress has accelerated; we have had better data and better methods of analysis year by year. We all recognize the debt we owe to the great analysts, the Galtons, Pearsons, Yules and Fishers. We should as gladly acknowledge the debt to the Fluxes and Macrostys, whose self-denying labours, honoured indeed in our Society, but not often by those who dispense the conventional honours of scientific prowess, have equally contributed to the advancement of statistical science.

When the time comes to rebuild a shattered civilization, the young men and women whose task it will be should profit from the labours of our colleagues. I say *should*: whether they actually *will* profit is another question. It is difficult to avoid the conclusion that in practical affairs the cynical epigram—the lesson of history is that we learn nothing from history—is more of a platitude than a paradox. In the world of the spirit it is otherwise. In one of Mr. Wells's tales, a mathematician who has (correctly) forecast the appearance of a star which will destroy civilization still feels the joy that an intellectual achievement always brings. Whatever is to happen in the future, nothing can deprive us of the pleasure which such a retrospect as that of our President gives. It has all been worth while; it has been good to have a share in all these things. We can wholeheartedly greet the unseen with a cheer.

The PRESIDENT, in reply: One is never too old or too young—for it appears I am both!—to be gratified by the discriminating praise of appreciative friends, and I openly confess that the kind words of Professor Bowley and Professor Greenwood have given me great pleasure. It would have been still more pleasant to have heard them spoken in a Meeting of the Society. I can only thank them for what they have said, and the body of the Fellows for the confidence which they have reposed in me.

I agree with Professor Greenwood that we can look back on the last few decades with some satisfaction. I agree also with Professor Bowley that much remains to be done, but he will not lure me into reopening the old controversy about a Central Statistical Department. I do, however, throw out another suggestion for consideration. I should like to see an Advisory Committee on Statistics, composed partly of official statisticians, partly of unofficial statisticians, and partly of representatives of the various classes of people who have to furnish the raw material of statistics. It might have sub-committees to deal with the various kinds of statistics, but it should also meet periodically as a deliberative body. This, however, is neither the time nor the place to elaborate this idea.

Again I repeat my heartfelt thanks.

Secular Changes in Death Rates

By E. C. Rhodes

I

To those who are interested in the changes with time in the total population of a community, the equation

$$P(t) = \int_0^A B(t-x)l(x)dx$$

is familiar.

$P(t)$ stands for the population at time t, $B(t)$ is the number of births at time t, $l(x)$ is the chance, at birth, of attaining age x, and A is the upper limit of age at death.

This equation assumes that, throughout the course of time, the chances of death at different ages are unchanged. But, in actuality, this assumption is untrue. The equation must be modified if we are to bring into account changing mortality rates.

If $q(x, t)h$ is the chance of dying in the small interval of time $t, t+h$ when aged between x and $x+h$, then we may write down the chance, at birth, of a person's survival for x years, as the continued product of a number of chances of the person's not dying within successive small intervals of time. This chance is

$$\prod_{r=0}^{n-1} (1 - q(rh, t-x+rh)h),$$

where $nh = x$. This is the chance of survival to age x, at time t. Since h is small we may replace this product by

$$e^{-\sum_{\substack{|r=0}}^{n-1} q(rh, t-x+rh)h}.$$

This may be written in a form involving an integral as

$$e^{-\int_0^x q(y, t-x+y)dy}.$$

If mortality does not change with time this expression becomes

$$e^{-\int_0^x q(y)dy}$$

and since $q(y) = -\dfrac{d}{dy}(\log l(y))$, the chance now becomes $l(x)$, as it should.

Our equation connecting the population function $P(t)$ with the birth function $B(t)$ therefore becomes, assuming changing mortality,

$$P(t) = \int_0^A B(t-x)s(x,t)dx,$$

where

$$s(x,t) = e^{-\int_0^x q(y,\, t-\tau+y)dy}$$

Obviously, we must consider the integral $\int_0^x q(y, t-x+y)dy$ before we can proceed further with a discussion of the above equation.

Recently, Professor Greenwood in his valedictory address to the Society in 1936 on " English Death-rates, Past, Present and Future," *Journal of the Royal Statistical Society*, 1936, pp. 674 *et seq.*, traced the changes in death-rates at various ages since 1841, and discussed recent work by Cramèr and Wold and by Kermack, McKendrick and McKinlay. Professor Greenwood and these writers and V. P. A. Derrick in the *Journal of the Institute of Actuaries*, July, 1927, " Observations on (1) Errors of Age in the Population Statistics of England and Wales and (2) the Changes in Mortality indicated by the national records," all discuss changes in the function $q(y, t)$ or the allied function $\mu(y, t)$, where μ stands for the force of mortality, when y and t both vary. As an alternative to following the changes in these functions with changing values of y, keeping t constant, they consider the changes which take place when both y and t vary, but $y-t$ remains constant. This method is referred to as the " generation " method. Here, at each stage, we are dealing with the mortality of the survivors of the same original group of persons. Kermack, McKendrick and McKinlay give an account of their work in the *Lancet*, 1934, i, p. 698, and in the *Journal of Hygiene*, vol. 34, 1934, p. 433. These authors find that an assumption that the mortality rate at age y is dependent on two factors, (1) the age y, and (2) the mortality rate t years before of the group then aged $y-t$, is reasonable and deduce that

$$\mu(y, t) = Q(y) \,.\, R(y-t).$$

Here $\mu(y, t)$ is the force of mortality at age y, at time t. $Q(y)$ is a function of the age y alone, and $R(y-t)$ is the generation function involving the difference between the age y and the time t.

This relationship can be tested in a simple manner, for

$$\mu(y, t')/\mu(y, t) = R(y-t')/R(y-t).,$$

thus eliminating $Q(y)$.

II. *English Mortality Experience*

The following table has been computed from the death-rates of English females, in 10-year age groups, from age 25, and in 5-year periods from 1841 to 1930.

We take an origin for time at the year $1842\frac{1}{2}$, and we will call $y - t = \theta$. The age (y) for each group is taken as the middle age, 30, 40, etc. The time (t) for each period is taken as the middle year. Thus $\mu(30, 0)$ stands for the mortality rate for females aged 25–34 in the period 1841–45, $\mu(30, 5)$ stands for the mortality rate for females aged 25–34 in the period 1846–50, $\mu(40, 10)$ stands for the mortality rate for females aged 35–44 in the period 1851–55, and so on. So we get $\dfrac{\mu(30, 5)}{\mu(30, 0)} = \dfrac{R(25)}{R(30)}$, $\dfrac{\mu(40, 15)}{\mu(40, 10)} = \dfrac{R(25)}{R(30)}$, etc. We can therefore get a number of values of each of $R(\theta)/R(30)$ for different values of θ.

TABLE I

Values of $R(\theta)/R(30)$

θ	Ages						Average
	30	40	50	60	70	80	
80						0·981	0·981
75						1·042	1·042
70					1·000	1·022	1·011
65					1·061	0·982	1·021
60				0·948	1·010	0·996	0·996
55				1·035	0·983	1·013	1·013
50			0·974	0·969	1·000	1·008	0·991
45			1·097	0·923	1·000	1·009	1·004
40		0·960	1·019	0·972	1·037	0·961	0·972
35		1·087	0·955	0·972	1·029	0·985	0·985
30	1·000	1·000	1·000	1·000	1·000	1·000	1·000
25	1·130	0·937	1·019	0·997	1·044	0·946	1·008
20	1·040	0·960	1·026	0·979	1·066	0·893	1·002
15	0·970	0·960	0·987	1·003	0·994	0·891	0·978
10	0·990	0·952	0·981	1·028	0·932	0·875	0·966
5	0·970	0·897	0·968	0·953	0·903	0·857	0·928
0	0·929	0·865	0·981	0·885	0·879	0·849	0·882
− 5	0·808	0·821	0·923	0·847	0·811	0·849	0·834
−10	0·798	0·802	0·845	0·791	0·782		0·798
−15	0·697	0·722	0·774	0·711	0·782		0·722
−20	0·667	0·635	0·735	0·648			0·657
−25	0·566	0·563	0·671	0·617			0·591
−30	0·505	0·516	0·568				0·516
−35	0·455	0·508	0·542				0·508
−40	0·414	0·397					0·405
−45	0·556	0·373					0·457
−50	0·364						0·364
−55	0·333						0·333

The average figures in the last column in Table I are the antilogs of the medians of the logs of the figures in the body of the

table.   The original computations were done from logs of the original
death-rates.   When it was a question of averaging figures in order
to obtain values of $R(\theta)/R(30)$ it was thought advisable to use the
median instead of the arithmetic mean.   The influence of an item
different from the rest due to special mortality conditions of a certain
period is thus reduced.

The average figures in the final column are taken to represent
$R(\theta)/R(30)$ for different values of θ.   They are shown in Fig. 1.
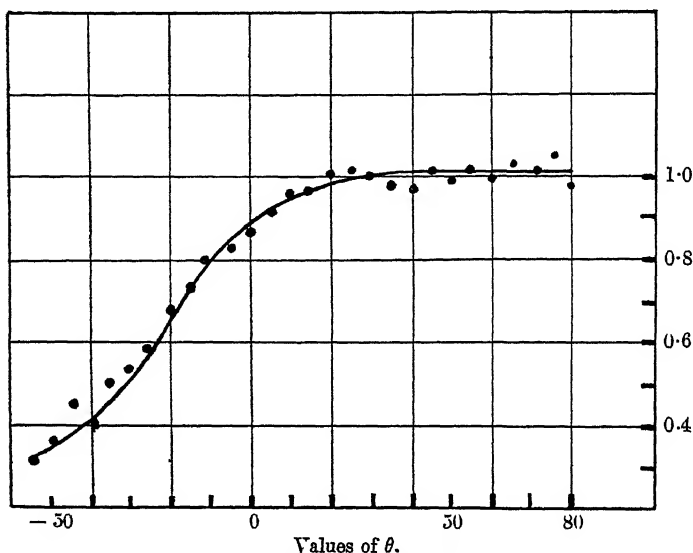
Values of θ.

FIG. 1.—Values of $R(\theta)/R(30)$.

It will be seen that $R(\theta)$ increases as θ increases until it appears
to attain a maximum.   In view of the nature of this function, $R(0)$,
it was thought worth while to fit a logistic equation to the values
of $R(\theta)$.   This equation corresponds to a curve which increases from
a minimum value, finally attaining asymptotically a maximum.
Although the graph in Fig. 1 does not suggest a tendency to a
minimum value when θ becomes large negatively, yet since this
function comes into our work from the equation

$$\mu(y, t) = Q(y) \cdot R(y - t)$$

where μ and Q represent rates of mortality, it is impossible that R
should be negative, and unreasonable to suppose that practically it
can have a minimum value zero.   But Fig. 1 certainly suggests
that $R(\theta)$ tends to a maximum in the usual manner of a logistic
function.

We therefore assume that $R(\theta)$ has the form

$$R(0) = \frac{A + Be^{-\tau(\theta - \beta)}}{1 + e^{-\tau(0 - \beta)}}.$$

The point of inflexion occurs when $\theta = \beta$.

If θ is measured from the value corresponding to the point of inflexion we have

$$R(\theta) + R(-\theta) = \frac{A + Be^{-\tau\theta}}{1 + e^{-\tau\theta}} + \frac{A + Be^{\tau\theta}}{1 + e^{\tau\theta}} = A + B.$$

From the values of $R(\hat{\theta})/R(30)$ given in Table I we can locate approximately the point of inflexion. The details are shown in the next table.

Assume point of inflexion at $0 = -20$.

θ	$\dfrac{R(\theta)}{R(30)}$	θ	$\dfrac{R(\theta)}{R(30)}$	Total
15	0·978	−55	0·333	1·311
10	0·966	−50	0 364	1·330
5	0·928	−45	0·457	1·385
0	0·882	−40	0·405	1·287
− 5	0·834	−35	0·508	1·342
−10	0·798	−30	0·516	1·314
−15	0·722	−25	0·591	1·313
−20	0·657	−20	0·657	1·314

The totals obtained when the point of inflexion is assumed to be at $0 = -20$ appear to be without trend upwards or downwards. We will assume that the point of inflexion is located at $0 = -20$. Then, averaging the totals shown in the table, by taking the median, we get $A + B = 1·314$.

It is a fairly easy matter, having fixed the point of inflexion, to obtain the constants of the logistic expression which reasonably well describes the data. Actually, in the computations which followed we neglected to take into account the values of $R(\theta)/R(30)$ given in Table I for values of θ from 8o to 2o inclusive. But we arranged that the value of $R(\theta)/R(30)$ for $\theta = 30$ should be unity.

We had this equation,

$$R(\theta)/R(30) = 0·30385 + \frac{0·70631}{1 + e^{-0·08455(\theta + 20)}}.$$

The theoretical values of $R(\theta)/R(30)$ deduced from this equation are given in Table II, together with the original values from Table I.

TABLE II
Values of $R(\theta)R(30)$

θ	80	75	70	65	60	55	50
Formula	1·010	1·010	1·010	1·010	1·009	1·009	1·008
Table II	0·981	1·042	1·011	1·021	0·996	1·013	0·991
Difference per cent. ...	−2·9	+3·2	+0·1	+1·1	−1·3	+1·4	−1·7

θ	45	40	35	30	25	20	15
Formula	1·007	1·006	1·003	1·000	0·995	0·987	0·975
Table II	1·004	0·972	0·985	1·000	1·008	1·002	0·978
Difference per cent. ...	−0·3	−3·4	−1·8	0	+1·3	+1·5	+0·3

θ	10	5	0	−5	−10	−15	−20
Formula	0·958	0·934	0·900	0·855	0·798	0·731	0·657
Table II	0·966	0·928	0·882	0·834	0·798	0·722	0·657
Difference per cent. ...	+0·8	−0·6	−2·0	−2·6	0	−1·2	0

θ	−25	−30	−35	−40	−45	−50	−55
Formula	0·583	0·516	0·459	0·414	0·380	0·356	0·339
Table II	0·591	·516	0·508	0·405	0·457	0·361	0·333
Difference per cent. ...	+1·4	0	+10·7	−2·0	+20·2	+2·2	−1·6

The curve corresponding to this equation is shown in Fig. 1.

TABLE III
Values of $Q(y) . R(30)$

Values of t	Period	Values of y					
		30	40	50	60	70	80
		(25–)	(35–)	(45–)	(55–)	(65–)	(75–)
0	1841–45	9·90	12·03	14·98	26·95	58·53	130·5
5	1846–50	11·26	13·65	16·88	29·44	62·10	138·6
10	1851–55	10·44	12·60	15·71	27·57	59·15	135·9
15	1856–60	9·84	11·86	14·75	26·31	57·59	130·6
20	1861–65	10·20	12·26	15·50	27·74	58·62	132·6
25	1866–70	10·28	12·41	15·88	27·80	58·67	134·9
30	1871–75	10·22	12·53	16·11	28·70	60·95	134·2
35	1876–80	9·36	12·10	15·69	28·75	60·59	134·5
40	1881–85	9·90	12·11	15·86	28·47	59·10	128·3
45	1886–90	9·44	12·05	16·06	29·53	62·02	131·8
50	1891–95	10·05	12·66	16·88	30·78	63·84	134·3
55	1896–1900	9·60	12·46	16·72	29·34	59·98	127·7
60	1901–05	9·69	12·18	16·42	28·22	57·18	121·5
65	1906–10	9·81	12·17	16·42	28·42	56·85	122·6
70	1911–15	9·91	12·60	17·35	28·45	57·43	122·6
75	1916–20	14·47	13·95	17·82	27·92	55·78	123·2
80	1921–25	10·12	12·08	17·05	28·31	57·64	126·6
85	1926–30	9·74	12·37	18·30	30·33	62·96	133·3
Averages		9·90	12·31	16·26	28·43	58·89	131·2

If we may regard the equation for $R(\theta)$ as reasonably describing the changes taking place in the computed values of $R(\theta)$ given in Table I, we may now proceed to obtain values of the other function $Q(y)$.

If we divide the tabulated values of $\mu(y, t)$ by the appropriate $R(y - t)$ we shall get $Q(y)$ for different values of y. The values in Table II are those for $R(\theta)/R(30)$. Thus we shall get values of $Q(y)R(30)$ when we do the appropriate divisions. For instance, the tabulated value of $\mu(y, t)$ for $y = 60$, $t = 10$ (corresponding to the period 1851–55) is 27·8. Dividing this by $\dfrac{R(50)}{R(30)}$, which is 1·008, we get 27·57. The values of $Q(y)R(30)$ are given in Table III.

In this table we have 18 values of $Q(y)$ for each value of y, 30, 40, 50, 60, 70 and 80. The averages taken are the antilogs of the medians of the logs of the figures in each column of the table. The computations were done with logarithms and the medians were used in order that extreme values due to special conditions of particular years should not have undue influence.

The values of $Q(y) . R(30)$ are therefore taken as :—

η	30	40	50	60	70	80
	9·90	12 31	16·26	28·43	58·89	131·2

These values increase fairly rapidly for increasing values of y and it is natural to attempt to fit a Makeham formula to them.

We get $Q(y) . R(30) = 8·34 + 1·4183\,(2·442)^{\frac{y-30}{10}}$.

The values obtained from this formula are compared below with the original values.

$$Q(y) . R(30)$$

η	30	40	50	60	70	80
Formula	9·76	11·80	16·80	28·99	58·78	131·5
Original	9·90	12·31	16·26	28·43	58·89	131·2
Differences, per cent.	+1·4	+4·3	−3·2	−1·9	+0·2	−0·2

The Makeham formula thus reasonably well describes the original values of $Q(y) . R(30)$.

We may now reconstruct the values of $\mu(y, t)$ from the full formula

$$\mu(y, t) = Q(y) . R(y - t).$$

We get $\quad \mu(y, t) = \left\{ 8·34 + 1·4183\,(2·442)^{\frac{y-30}{10}} \right\} \times$

$$\left\{ 0·30385 + \frac{0·70631}{1 + e^{-0·08455(y - t + 20)}} \right\},$$

t being measured in years from 1842·5 and y is the age in years.

This formula may be written in the form

$$\mu(y, t) = \{8\cdot34 + 0\cdot09739 \,(1\cdot09341)^y\}$$
$$\left\{0\cdot30335 + \frac{0\cdot70631}{1 + 0\cdot18432(1\cdot08823)^{-(y-t)}}\right\}.$$

TABLE IV

English females.   Values of $\mu(y, t)$ from formula together with original quinquennial death-rates at ages

Period	Ages								
	25–			35–			45–		
	For-mula	Origi-nal	Differ-ence per cent.	For-mula	Origi-nal	Differ-ence per cent.	For-mula	Origi-nal	Differ-ence per cent.
1841–45 ...	9 76	9·9	+ 1·4	11·87	12·1	+ 2·0	16·94	15·1	−10·9
1846–50 ...	9·71	11·2	+15·4	11·84	13·7	+15·7	16·92	17·0	+ 0·5
1851–55 ...	9·63	10·3	+ 6·9	11·80	12·6	+ 6·8	16·90	15·8	− 6·5
1856–60 ...	9·52	9·6	+ 0·9	11·74	11·8	+ 0·5	16·86	14·8	−12·2
1861–65 ...	9·35	9·8	+ 4·8	11·65	12·1	+ 3·9	16·80	15·5	− 7·7
1866–70 ...	9·12	9·6	+ 5·3	11·51	12·1	+ 5·1	16·71	15·8	− 5·5
1871–75 ...	8·79	9·2	+ 4·7	11·31	12·0	+ 6·1	16·58	15·9	− 4·1
1876–80 ...	8·35	8·0	− 4·1	11·02	11·3	+ 2·5	16·39	15·3	− 6·6
1881–85 ...	7·79	7·9	+ 1·4	10·62	10·9	+ 2·6	16·10	15·2	− 5·6
1886–90 ...	7·13	6·9	− 3·2	10·09	10·3	+ 2·1	15·69	15·0	− 4·4
1891–95 ...	6·41	6·6	+ 2·9	9·42	10·1	+ 7·3	15·12	15·2	+ 0·5
1896–1900 ..	5·69	5·6	− 1·7	8·62	9·1	+ 5·6	14·37	14·3	− 0·5
1901–05 ...	5·04	5·0	− 0·7	7·75	8·0	+ 3·2	13·41	13·1	− 2·3
1906–10 ...	4·45	4·5	+ 0·5	6·89	7·1	+ 3·1	12·27	12·0	− 2·2
1911–15 ...	4·04	4·1	+ 1·5	6·09	6·5	+ 6·8	11·04	11·4	+ 3·3
1916–20 ...	3·71	5·5	+48·3	5·42	6·4	+18·2	9·80	10·4	+ 6·1
1921–25 ...	3·47	3·6	+ 3·7	4·88	5·0	+ 2·4	8·67	8·8	+ 1·5
1926–30 ...	3·31	3·3	− 0·2	4·48	4·7	+ 4·8	7·71	8·4	+ 9·0
Median ...		3·1			4·4			4·9	

Period	Ages								
	55–			65–			75–		
	For-mula	Origi-nal	Differ-ence per cent.	For-mula	Origi-nal	Differ-ence per cent.	For-mula	Origi-nal	Differ-ence per cent.
1841–45 ...	29·26	27·2	−7·0	59·36	59·1	−0·4	132·8	131·8	−0·8
1846–50 ...	29·25	29·7	+1·5	59·34	62·7	+5·7	132·8	140·0	+5·1
1851–55 ...	29·23	27·8	−4·9	59·32	59·7	+0·6	132·8	137·2	+3·3
1856–60 ...	29·20	26·5	−9·0	59·30	58·1	−2·0	132·8	131·9	−0·7
1861–65 ...	29·16	27·9	−4·3	59·26	59·1	−0·3	132·7	133·8	+0·8
1866–70 ...	29·09	27·9	−4·1	59·21	59·1	−0·2	132·7	136·1	+2·6
1871–75 ...	28·99	28·7	−1·0	59·12	61·3	+3·7	132·6	135 3	+2·0
1876–80 ...	28·84	28·6	−0·8	58·99	60·8	+3·1	132·5	135·5	+2·3
1881–85 ...	28·61	28·1	−1·8	58·78	59·1	+0·5	132·3	129·0	−2·5
1886–90 ...	28·27	28·8	+1·9	58·47	61·7	+5·5	132·0	132·3	+0·2
1891–95 ...	27·75	29·5	+6·2	58·01	63·0	+8·6	131·5	134·3	+2·1
1896–1900 ...	27·08	27·4	+1·2	57·33	58·5	+2·0	130·8	127·0	−2·9
1901–05 ...	26·10	25·4	−2·7	56·33	54·8	−2·7	129·8	119·9	−7·6
1906–10 ...	24·79	24·3	−2·0	54·90	53·1	−3·3	128·8	119·6	−6·8
1911–15 ...	23·13	22·7	−1·9	52·91	51·7	−2·3	126·0	117·5	−6·8
1916–20 ...	21·18	20·4	−3·7	50·26	47·7	−5·1	122·8	115·1	−6·3
1921–25 ...	19·05	18 6	−2·3	46·91	46 0	−1·9	118·4	114·0	−3·7
1926–30 ...	16·92	17·7	+4 6	42·91	46·0	+7·1	112·5	114·0	+1·4
Median ...		2·5			2·5			2·5	

The various values of $\mu(y, t)$ obtained from the formula on p. 22
are compared with the original values in Table IV, and in Fig. 2.

Some of these results may be compared with certain results
obtained by Professor Greenwood, applying the generation method
of Kermack, McKendrick and McKinlay. He also fitted logistics
separately to the quinquennial rates for ages 45–, 55–, and 65–,
adopting a method of determining the constants similar to that used
in this paper. In order to make appropriate comparisons, his results,
given on pp. 699–700 of his valedictory address, have been used.
The medians of the percentage differences have been computed for
comparison with those in Table IV.

*Comparison of median percentage differences between graduations
and original figures*

	Age	45–	55–	65–
Greenwood	Generation ...	4·5	2·3	2·7
	Logistic 1 ...	2·1	1·9	2·8
	Logistic 2 ...	2·1		
Rhodes		4·9	2·5	2·5

Judged by this criterion the theoretical values obtained by Pro-
fessor Greenwood describe the original data more successfully than
do those obtained in the present paper, but the present results are
not greatly out of accord. We may be satisfied that the formula
giving the rates for different ages at different periods does give fair
agreement with the recorded changes.

Referring back to Table IV we note that the discrepancy between
the formula and the original figures for ages 35– is biased. The
formula does not adequately represent the facts.

For certain periods the mortality experience is always in excess
of that indicated by the formula, for instance, 1846–50 and 1891–95.
The large differences between the observed and the computed for
1916–20 for ages 25–44 are pronounced.

The formula for $\mu(y, t)$ gives us the following extreme cases

$$\mu(y, -\infty) = 1 \cdot 01016(8 \cdot 34 + 0 \cdot 09739(1 \cdot 09341)^y)$$
$$\mu(y, +\infty) = 0 \cdot 30385(8 \cdot 34 + 0 \cdot 09739(1 \cdot 09341)^y)$$

The rates are tending to lower levels, about 30 per cent. of the value
of the levels from which they started.

In the following table the rates computed from the formula are
shown for various periods of time.

Period			Ages					
			25–	35–	45–	55–	65–	75–
− ∞	...	...	9·9	11·9	17·0	29·3	59 4	132·8
1926–30	...	...	3·3	4·5	7·7	16·9	42·9	112·5
1951–55	...	...	3·0	3·7	5·5	10·3	24·3	67·9
+ ∞	...	...	3·0	3·6	5·1	8·8	17 9	40 0

The mortality rates at the younger ages are becoming stabilized at the present time, while considerable reduction may be expected in the rates at the older ages.

In the preceding work attention has been confined to the rates for ages 25 and upwards because the Makeham curve only gives satisfactory graduations for the older age groups. But the general method of Kermack, McKendrick and McKinlay is not confined to these older ages. Let us now deal with the remaining part of the table of mortality rates for ages 0–4, 5–9, 10–14, 15–19, 20–24. The original table of mortality rates is given by Professor Greenwood, on p. 677 of his address.

We find values of $R(\theta)$ $'R(2\frac{1}{2})$ in the manner previously described. But now the values obtained for age groups 0–4 and 5–9 do not seem to fit in very well with those obtained from the other age groups. The assumption of Kermack, McKendrick and McKinlay is probably not valid for those ages. We therefore leave them out of account.

We proceed as follows. From the formula for $R(\theta)$, $'R(30)$ already obtained from the previous work we obtain $R(2\frac{1}{2})/R(30)$. We can therefore obtain from the formula values of $R(\theta)/R(2\frac{1}{2})$ for different values of θ. These are applied to the original mortality rates to give us values of $Q(y) . R(2\frac{1}{2})$. From these we get averages, which can be expressed in the form $Q(y) . R(30)$ for $y = 12\frac{1}{2}$, $17\frac{1}{2}$, $22\frac{1}{2}$ corresponding to age groups 10–14, 15–19, 20–24.

These values are shown below together with those previously computed.

y	$12\frac{1}{2}$	$17\frac{1}{2}$	$22\frac{1}{2}$	30	40	50	60	70	80
$Q(y) . R(30)$	5·88	7·77	8 74	9·90	12·31	16·26	28 43	58·89	131·2

The Makeham curve which was fitted to these values of $Q(y) . R(30)$ from $y = 30$ does not, of course, describe the values for $y = 12\frac{1}{2}$, $17\frac{1}{2}$, $22\frac{1}{2}$. No attempt has been made to fit a curve to the whole of these values of $Q(y)$ from $y = 12\frac{1}{2}$ to $y = 80$.

We now reconstruct the values of $\mu(y, t)$ from the formula $\mu(y, t) = Q(y) . R(y - t)$.

TABLE V

English females.   Values of $\mu(y, t)$ and original death-rates at ages

Period	Ages								
	10–			15–			20–		
	Formula	Original	Difference per cent.	Formula	Original	Difference per cent.	Formula	Original	Difference per cent.
1841–45 ...	5·69	5·2	− 8·6	7·63	7·7	+ 0·9	8·66	8·6	− 0·7
1846–50 ...	5·57	5·7	+ 2·3	7·52	8·1	+ 7·7	8·58	9·6	+11·9
1851–55 ...	5·40	5·3	− 1·9	7·36	7·8	+ 5·9	8·45	8·9	+ 5·3
1856–60 ...	5·17	4·8	− 7·2	7·14	7·1	− 0·6	8·28	8·2	− 0·9
1861–65 ...	4·87	4·8	− 1·4	6·84	6·9	+ 1·0	8·02	8·2	+ 2·2
1866–70 ...	4·50	4·3	− 4·5	6·41	6·4	− 0·6	7·68	7·8	+ 1·5
1871–75 ...	4·08	4·0	− 2·0	5·95	5·9	− 0·8	7·23	7·4	+ 2·3
1876–80 ...	3·65	3·5	− 4·0	5·40	5·0	− 7·4	6·69	6·2	− 7·3
1881–85 ...	3·23	3·3	+ 2·3	4·82	4·7	− 2·5	6·07	5·9	− 2·7
1886–90 ...	2·86	2·9	+ 1·5	4·27	4·2	− 1·3	5·42	5·2	− 4·0
1891–95 ...	2·56	2·7	+ 5·6	3·78	4·0	+ 5·9	4·79	4·8	+ 0·1
1896–1900 ...	2·33	2·4	+ 3·2	3·38	3·1	+ 0·6	4·25	4·1	− 3·4
1901–05 ...	2·16	2·2	+ 2·0	3·08	3·0	− 2·5	3·80	3·7	− 2·6
1906–10 ...	2·04	2·1	+ 3·1	2·85	2·8	− 1·8	3·46	3·3	− 4·5
1911–15 ...	1·95	2·1	+ 7·4	2·69	2·8	+ 1·0	3·20	3·2	− 0·1
1916–20 ...	1·90	2·6	+37·0	2·58	3·7	+43·2	3·03	4·5	+48·7
1921–25 ...	1·86	1·7	− 8·6	2·51	2·6	+ 3·6	2·90	3·1	+ 6·8
1926–30 ...	1·84	1·5	−18·3	2·46	2·4	− 2·4	2·82	3·0	+ 6·4
Median ...			3·6			2·4			3·1
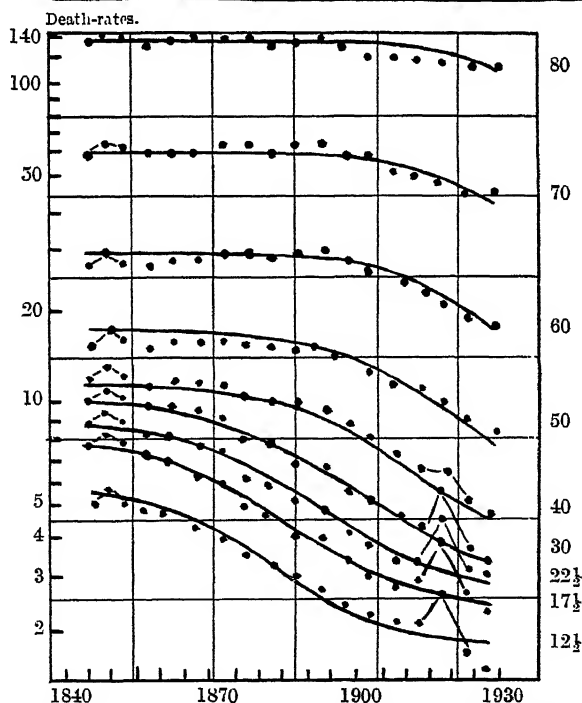
FIG. 2.—England and Wales.   Female Death-rates at Ages.
(The figures on the right of each curve represent ages.)

The theoretical figures are sufficiently in accord with the original data for us to regard them as a fair graduation. Again, we note the heavy mortality experience of the periods 1846–50 and 1916–20.

We may conclude that the formula

$$\mu(y, t) = Q(y) \cdot R(y - t)$$

satisfactorily describes the data from ages 10 and upwards. For these values of y the function R may be taken as a logistic function. For ages 30 and upwards $Q(y)$ may be taken as a Makeham curve. It was not thought worth while to express, in a simple functional form, $Q(y)$ between ages 10 and 30.

III. *Mortality experience of Sweden*

In " Mortality Variations in Sweden " by H. Cramèr and H. Wold, *Skandinavisk Aktuarietidskrift*, 1925 (pp. 161–241), these authors give in Table 3b, p. 213, values of μ for females for 12 five-year age groups from 30 to 90 for 26 quinquennia from 1800 to 1930. The authors analyse these data in order to obtain graduations. Professor Greenwood, in his address already referred to, gives an account of their work, so only a brief description of that part which interests us at the moment will be given here. They fit Makeham curves to the diagonal values of their double table, ages being represented one way and periods the other. The constants of these Makeham curves are then graduated by fitting logistic curves or straight lines.

We have used the same method as that used in the first part on the English data, *i.e.*, assuming that

$$\mu(y, t) = Q(y) \cdot R(y - t)$$

we obtain values of $R(\theta)$ for different values of θ. We measured t from 1800, and our values of θ range from 85 to -95 in 5-year intervals. As we have more data at our disposal than we had from the England and Wales figures, we have restricted ourselves, when attempting to find the constants of $R(\theta)$, to those values corresponding to θ ranging from 50 to -60 inclusive. Most of these values of $R(\theta)$ which are thus graduated are averages of 12 items. The extreme values are averages of 8 items. Again the median was used for averaging. A logistic curve was used for $R(\theta)$ for reasons previously stated, though it must be admitted that the graph of the values of $R(\theta)$ plotted against θ would suggest a straight line as equally appropriate. Obviously a straight line is not applicable in the present case. Fig. 3, where the original values of R are shown, together with the final smooth curve used subsequently, shows this. Unfortunately, owing to the apparent lack of curvature in the graph

of $R(\theta)$ as originally plotted it is difficult to estimate the position of the point of inflexion of the logistic curve. This was established by first fitting a cubic to the data.
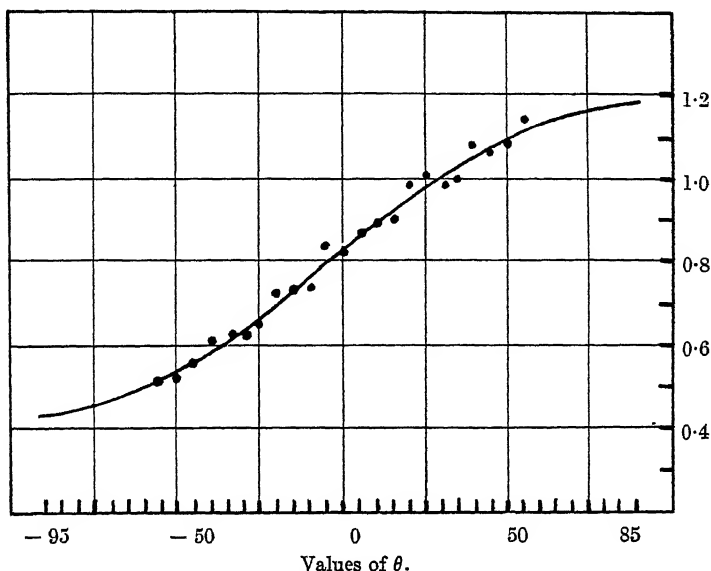
Fig. 3.—Values of $R(\theta)/R(30)$.

The equation of the logistic is

$$\frac{R(\theta)}{R(30)} = 0{\cdot}3917 + \frac{0{\cdot}83811}{1 + 0{\cdot}78964(1{\cdot}03199)^{-\theta}},$$

θ being measured in years.

In Table VI we show the original values of $R(\theta)$ together with those from the formula.

When the appropriate values of $R(\theta)/R(30)$ obtained from the logistic are divided into the original values of μ we get values of $Q(y) . R(30)$. Thus for $y = 42\frac{1}{2}$, $t = 22\frac{1}{2}$, corresponding to the period 1820–25, we have, from the original data $\mu = 11{\cdot}70$; θ is 20 and $R(20)/R(30) = 0{\cdot}982$. Hence $Q(42\frac{1}{2})R(30)$ from this computation is $11{\cdot}92$.

For each value of y from $32\frac{1}{2}$ to $87\frac{1}{2}$ we have 26 values of $Q(y) . R(30)$. The median is used to represent these and we have the following values. Table VII also shows the smooth values computed later.

Following precedent, we naturally expect to smooth these values of $Q(y)$ by means of a Makeham curve. Unfortunately, the whole series does not seem to lend itself to a satisfactory graduation by

TABLE VI

*Original values of R(θ)/R(30) and theoretical values from the
logistic*

θ	85	80	75	70	65	60	55	50	45	40
Theoretical	1·187	1·180	1·172	1·163	1·152	1·140	1·127	1·112	1·095	1·076
Original								1·136	1·084	1·071
Difference per cent. ...								+2·0	−1·0	−0·5

θ	35	30	25	20	15	10	5	0	−5	
Theoretical	1·056	1·033	1·008	0·982	0·953	0·923	0·892	0·860	0·827	
Original	1·057	1·000	0·989	1·004	0·981	0·905	0·897	0·866	0·816	
Difference per cent. ...	+3·0	−3·2	−1·9	+2·2	+2·9	−2·0	+0·6	+0·7	−1·4	

θ	−10	−15	−20	−25	−30	−35	−40	−45	−50	
Theoretical	0·794	0·761	0·729	0·698	0·668	0·640	0·613	0·589	0·566	
Original	0·827	0·736	0·729	0·717	0·657	0·623	0·620	0·604	0·564	
Difference per cent. ...	+4·1	−3·3	0	+2·4	−1·7	−2·7	+1·2	+2·6	−0·3	

θ	−55	−60	−65	−70	−75	−80	−85	−90	−95	
Theoretical	0·545	0·526	0·509	0·494	0·481	0·469	0·459	0·450	0·442	
Original	0·530	0·525								
Difference per cent. ...	−2·8	−0·2								

TABLE VII

Values of Q(y) . R(30)

y	32½	37½	42½	47½	52½	57½
Original	11·72	12·83	14·16	14·88	18·67	24·26
Theoretical ...	11·50	12·81	14·27	15·90	17·71	23·66

y	62½	67½	72½	77½	82½	87½
Original	34·89	52·38	80·70	122·95	186·47	271·95
Theoretical ...	35·62	53·62	80·71	121·50	182·90	275·33

this method. But we find that the last seven values (from $y = 57\frac{1}{2}$ onwards) can reasonably well be described by a simple exponential curve, and the first five by another exponential curve.

The original figures for $Q(y) . R(30)$ are shown with their smooth curves graphically on a logarithmic scale (Fig. 4).

We have

$$\text{for } y = 32\tfrac{1}{2} \text{ to } 52\tfrac{1}{2}, \ Q(y) . R(30) = 5\cdot6980 \ (1\cdot02183)^y,$$
$$\text{for } y = 57\tfrac{1}{2} \text{ to } 87\tfrac{1}{2}, \ Q(y) . R(30) = 0\cdot21434 \ (1\cdot08525)^y,$$

y being measured in years.

The values computed from these formulæ are given in Table VII.

We can now reconstruct the theoretical values of $\mu(y, t)$ from the formula $\mu(y, t) = Q(y) \cdot R(y - t)$.

These are shown in Table VIII.

Values of y (Age).
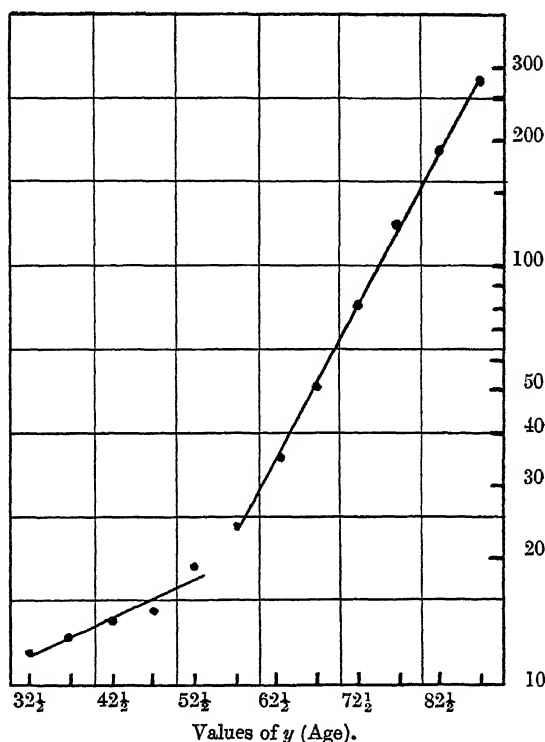
FIG. 4.—Values of $Q(y) \cdot R(30)$.

The formula is given by :—

$$\mu(y, t) = 5 \cdot 6980(1 \cdot 02183)^y \left(0 \cdot 3917 + \frac{0 \cdot 83811}{1 + 0 \cdot 78964(1 \cdot 03199)^{-(y - t)}} \right)$$

$$\text{for } y = 32\tfrac{1}{2} \text{ to } 52\tfrac{1}{2}$$

and

$$\mu(y, t) = 0 \cdot 21434(1 \cdot 08525)^y \left(0 \cdot 3917 + \frac{0 \cdot 83811}{1 + 0 \cdot 78964(1 \cdot 03199)^{-(y - t)}} \right)$$

$$\text{for } y = 57\tfrac{1}{2} \text{ to } 87\tfrac{1}{2},$$

t being measured from 1800 and y is measured in years.

The formulæ do represent the original data fairly well, but an examination in detail reveals that there are some large discrepancies.

TABLE VIII

Swedish females. Values of $\mu(y, t)$. (a) theoretical, (b) original

Period	Age												
	32½	37½	42½	47½	52½	57½	62½	67½	72½	77½	82½	87½
1800– (a)	11·87	13·52	15·36	17·41	19·69	26·67	40·62	61·78	93·84	142·37	215·75	326·74
(b)	9·16	10·83	13·35	14·17	20·28	26·59	39·19	55·48	91·08	140·01	219·78	292·76
1805– (a)	11·59	13·23	15·06	17·11	19·39	26·31	40·14	61·14	93·00	141·27	214·32	324·78
(b)	13·03	15·26	17·66	19·87	27·05	35·04	53·12	69·70	104·80	165·64	233·42	317·89
1810– (a)	11·29	12·91	14·74	16·78	19·06	25·91	39·60	60·43	92·04	139·99	212·66	322·63
(b)	10·98	12·76	14·60	16·50	21·86	29·19	43·60	64·59	97·12	139·23	215·52	313·06
1815– (a)	10·96	12·57	14·39	16·42	18·70	25·47	39·01	59·62	90·97	138·56	210·71	320·13
(b)	9·33	12·10	13·48	14·55	20·01	26·24	39·61	58·22	91·43	130·73	207·22	312·58
1820– (a)	10·62	12·21	14·01	16·03	18·29	24·98	38·34	55·72	89·75	136·94	208·58	317·24
(b)	8·12	9·77	11·70	12·47	16·44	22·92	35·53	49·43	76·32	115·22	179·04	251·91
1825– (a)	10·26	11·83	13·60	15·60	17·85	24·14	37·60	57·71	88·39	135·10	206·15	313·99
(b)	9·83	11·82	13·51	15·99	21·20	26·53	41·36	60·51	91·43	143·77	215·48	307·28
1830– (a)	9·89	11·43	13·15	15·15	17·38	23·85	36·79	56·60	86·88	133·06	203·39	310·33
(b)	9·82	11·60	13·78	16·06	20·76	26·78	38·05	57·63	87·01	127·10	202·11	290·47
1835– (a)	9·51	11·01	12·73	14·68	16·88	23·23	35·91	55·38	85·21	130·78	200·31	306·17
(b)	9·19	10·79	13·16	14·71	19·72	26·84	37·45	56·02	92·15	135·65	207·50	308·92
1840– (a)	9·13	10·59	12·27	14·18	16·35	22·55	34·96	54·06	83·37	128·27	196·87	301·51
(b)	7·79	9·55	11·32	12·75	16·51	22·90	33·01	51·74	80·34	126·76	194·22	266·00
1845– (a)	8·75	10·17	11·80	13·67	15·80	21·85	33·95	52·63	81·37	125·50	193·09	296·37
(b)	8·09	9·76	11·54	12·62	17·92	23·76	34·04	56·62	85·05	127·76	200·21	296·31
1850– (a)	8·38	9·75	11·83	13·15	15·23	21·11	32·89	51·11	79·23	122·50	188·92	290·67
(b)	8·57	10·45	12·32	13·62	18·10	24·62	36·19	56·34	87·17	128·79	184·11	268·22
1855– (a)	8·03	9·34	10·87	12·63	14·65	20·35	31·78	49·49	76·94	119·28	184·40	284·39
(b)	8·23	9·67	10·87	12·78	16·33	22·78	33·98	49·08	76·81	118·73	172·97	248·01
1860– (a)	7·68	8·94	10·41	12·10	14·07	19·57	30·63	47·84	74·53	115·82	179·56	277·59
(b)	6·76	8·05	9·36	10·60	14·07	19·68	29·99	44·56	69·01	110·88	170·43	259·47
1865– (a)	7·36	8·56	9·96	11·59	13·48	18·79	29·46	46·11	72·01	112·19	174·36	270·30
(b)	7·45	8·93	10·62	12·07	15·38	21·51	32·05	19·62	75·35	117·99	191·33	293·06
1870– (a)	7·05	8·20	9·53	11·10	12·91	18·02	28·29	44·35	69·41	108·40	168·89	262·48
(b)	7·50	8·63	9·68	10·28	13·69	18·45	27·47	42·82	67·29	103·75	159·87	261·66
1875– (a)	6·77	7·85	9·13	10·62	12·36	17·25	27·12	42·59	66·76	104·48	163·16	254·24
(b)	6·95	7·79	8·41	9·47	11·96	16·31	24·66	37·47	59·98	91·27	150·01	236·61
1880– (a)	6·50	7·54	8·75	10·17	11·83	16·52	25·97	40·83	61·11	100·50	157·30	245·65
(b)	6·74	7·57	8·30	9·18	11·54	15·70	23·77	36·77	55·10	91·81	150·68	232·01
1885– (a)	6·27	7·25	8·40	9·75	11·33	15·81	24·86	39·10	61·46	96·51	151·30	236·79
(b)	6·54	7·40	8·09	8·95	10·84	15·09	22·24	34·76	55·91	89·06	115·33	230·81
1890– (a)	6·05	6·98	8·07	9·36	10·86	15·14	23·80	37·43	58·86	92·52	145·28	227·76
(b)	6·67	7·38	8·03	8·79	10·98	14·70	22·17	35·18	56·26	95·35	145·14	231·14
1895– (a)	5·86	6·74	7·78	8·99	10·42	14·51	22·79	35·63	56·34	88·61	139·28	218·70
(b)	6·36	7·11	7·73	8·39	10·87	13·88	20·42	32·31	53·41	87·33	115·07	233·04
1900– (a)	5·68	6·53	7·51	8·66	10·02	13·93	21·84	34·21	53·93	84·82	133·39	209·67
(b)	6·42	6·85	7·47	8·42	10·37	13·91	20·02	30·76	50·71	86·09	139·20	220·15
1905– (a)	5·53	6·33	7·27	8·37	9·65	13·39	20·96	32·88	51·65	81·19	127·69	200·80
(b)	5·91	6·38	7·04	8·11	9·88	13·26	19·14	30·23	49·38	82·63	138·20	217·27
1910– (a)	5·40	6·16	7·05	8·10	9·32	12·89	20·15	31·56	49·50	77·75	122·22	192·21
(b)	5·76	6·13	7·09	7·74	9·77	12·95	19·37	30·84	50·19	84·76	110·24	224·78
1915– (a)	5·28	6·01	6·86	7·86	9·02	12·45	19·41	30·54	47·51	74·51	117·04	183·98
(b)	7·46	7·21	7·48	8·11	10·27	13·53	19·41	30·34	51·00	81·94	134·99	212·70
1920– (a)	5·17	5·88	6·70	7·65	8·75	12·05	18·75	29·22	45·67	71·51	112·17	176·19
(b)	1·46	4·69	5·70	6·86	9·01	12·38	18·75	29·27	47·65	81·12	132·82	213·23
1925– (a)	5·08	5·76	6·55	7·46	8·52	11·70	18·15	28·22	43·99	68·74	107·70	168·86
(b)	4·30	4·53	5·32	6·87	9·38	12·50	18·78	30·22	49·16	81·02	137·05	219·09

TABLE IX

Swedish females. Percentage differences between theoretical and original values of μ. (a) Rhodes, (b) Cramèr and Wold

Period	Age										
	32½	37½	42½	47½	52½	57½	62½	67½	72½	77½	82½	87½
1800– (a)	−22·8	−19·9	−13·1	−18·6	+ 3·0	− 0·3	− 3·5	−10·2	− 2·9	− 1·7	+ 1·9	−10·4
(b)	−17·5	−12·3	− 6·0	−16·7	− 4·9	− 4·9	+ 2·3	+ 2·0	+14·5	+17·5	+21·6	+ 5·5
1805– (a)	+12·4	+15·3	+17·3	+16·1	+39·6	+33·2	+32·3	+14·0	+12·7	+17·2	+ 8·9	+ 7·1
(b)	+19·5	+25·5	+25·9	+18·1	+28·0	+26·2	+39·4	+28·6	+32·1	+39·5	+29·3	+25·5
1810– (a)	−11·6	− 1·0	− 1·0	− 1·7	+14·7	+14·2	+10·1	+ 6·9	+ 5·5	− 0·5	+ 1·4	− 3·0
(b)	+ 2·6	+ 6·9	+ 5·6	− 0·8	+ 4·4	+ 6·1	+15·0	+19·6	+22·7	+17·5	+19·5	+13·0
1815– (a)	−14·9	− 3·7	− 6·3	−11·4	+ 7·0	+ 3·0	+ 1·5	− 2·4	+ 0·3	− 3·6	− 1·7	− 2·4
(b)	−11·1	+ 3·0	− 1·0	−11·1	− 3·5	− 4·2	+ 5·0	+ 8·2	+13·8	+10·4	+15·1	+13·3
1820– (a)	−24·4	−20·0	−16·5	−22·2	−10·1	− 8·2	− 7·3	−15·8	−15·0	−15·9	−14·1	−20·6
(b)	−20·4	−15·2	−12·7	−23·1	−19·9	−15·7	− 5·3	− 9·6	− 3·1	− 2·5	− 0·5	− 8·9
1825– (a)	− 4·2	− 0·1	+ 1·5	+ 2·5	+18·8	+10·2	+10·0	+ 4·0	+ 3·4	+ 6·4	+ 4·5	− 2·1
(b)	− 1·1	+ 5·0	+ 5·0	0	+ 4·4	− 0·1	+10·6	+13·3	+16·3	+21·9	+19·9	+11·2
1830– (a)	− 0·7	+ 1·5	+ 4·6	+ 6·0	+19·5	+12·3	+ 3·4	+ 1·8	+ 0·1	− 4·5	− 0·6	− 6·1
(b)	+ 2·0	+ 6·1	+ 7·3	+ 2·3	+ 3·5	+ 0·2	+ 2·6	+ 8·2	+11·0	+ 7·9	+12·6	+ 5·2
1835– (a)	− 3·4	− 2·0	+ 3·1	+ 0·2	+16·8	+15·5	+ 4·3	+ 1·2	+ 8·1	+ 3·7	+ 3·0	+ 0·9
(b)	− 0·4	+ 2·7	+ 5·8	− 4·0	+ 0·5	+ 1·5	+ 1·8	+ 5·8	+ 1·8	+15·4	+15·8	+11·9
1840– (a)	−14·7	− 9·8	− 7·7	−10·1	+ 1·0	+ 1·6	− 5·6	− 4·3	− 3·6	− 1·2	− 1·3	−11·8
(b)	−11·6	− 4·6	− 5·0	−14·0	−14·2	−11·9	− 9·4	− 1·6	+ 3·2	+ 8·1	+ 8·5	− 3·8
1845– (a)	− 7·5	− 4·0	− 2·2	− 7·7	+13·4	+ 8·7	+ 0·3	+ 7·6	+ 4·5	+ 1·5	+ 3·7	− 0·0
(b)	− 3·9	+ 2·8	+ 2·5	−10·6	− 3·4	− 6·5	− 5·1	+ 8·6	+ 9·9	+ 9·3	+12·0	+ 7·6
1850– (a)	+ 2·3	+ 7·2	+ 8·7	+ 3·6	+18·9	+15·6	+10·0	+10·2	+10·0	+ 5·1	− 2·5	− 7·7
(b)	+ 6·2	+10·1	+10·8	+ 2·9	+ 2·9	+ 0·7	+ 3·3	+ 9·6	+13·5	+10·7	+ 3·3	− 2·5
1855– (a)	+ 2·5	+ 3·5	0	+ 1·2	+10·8	+12·0	+ 6·9	− 0·8	− 0·2	− 0·5	− 6·2	−14·5
(b)	+ 5·9	+12·8	+ 9·0	+ 3·4	− 1·0	− 1·3	+ 0·8	− 2·3	+ 1·4	+ 2·8	− 2·5	−11·5
1860– (a)	−12·0	−10·0	−10·1	−12·4	0	+ 0·6	− 2·1	− 6·8	− 7·4	− 4·3	− 5·1	− 6·6
(b)	−10·0	− 1·9	− 0·7	− 8·5	− 7·7	− 8·2	− 5·6	− 7·7	− 6·8	− 2·7	− 3·4	− 5·1
1865– (a)	+ 1·6	+ 4·3	+ 6·6	+ 4·1	+14·1	+16·0	+ 8·8	+ 7·6	+ 4·7	+ 5·2	+ 9·7	+ 8·4
(b)	+ 3·6	+12·9	+18·5	+11·0	+ 7·9	+ 9·5	+ 8·9	+ 9·2	+ 5·9	+ 5·8	+10·6	+ 7·9
1870– (a)	+ 0·4	+ 5·2	+ 1·6	− 7·4	+ 6·0	+ 2·4	− 2·9	− 3·5	− 3·1	− 4·8	− 5·3	− 0·3
(b)	+ 5·9	+12·7	+12·7	+ 0·3	+ 2·7	− 1·3	0	+ 1·5	+ 0·4	− 3·8	− 6·1	− 2·4
1875– (a)	+ 2·7	− 0·8	− 7·9	−10·8	− 3·2	− 5·4	− 9·1	−12·0	−10·2	− 9·8	− 8·1	− 6·9
(b)	+ 0·1	+ 4·7	+ 1·3	− 3·1	− 4·0	− 6·7	− 5·4	− 5·7	− 4·0	− 6·5	− 8·5	− 9·9
1880– (a)	+ 3·7	+ 0·4	− 5·1	− 9·7	− 1·6	− 5·0	− 8·7	− 9·9	− 9·3	− 5·6	− 4·2	− 5·5
(b)	+ 0·7	+ 4·6	+ 3·0	− 2·5	− 1·4	− 3·4	− 3·3	− 3·9	− 2·4	− 0·0	− 2·8	− 8·3
1885– (a)	+ 4·3	+ 2·1	− 4·2	− 8·2	− 4·3	− 4·5	−10·5	−11·1	− 9·0	− 7·7	− 3·9	− 2·5
(b)	+ 0·6	+ 5·1	+ 2·5	− 2·1	− 4·3	− 1·4	− 2·4	− 4·7	− 4·5	− 2·0	− 0·7	− 3·8
1890– (a)	+10·2	+ 5·7	− 0·2	− 6·1	+ 1·1	− 2·9	− 6·9	− 6·0	− 4·4	+ 0·9	+ 2·0	+ 2·8
(b)	+ 5·7	+ 7·7	+ 5·2	− 1·2	− 0·2	+ 3·4	+ 3·9	+ 3·7	− 0·7	+ 1·2	+ 3·0	+ 2·5
1895– (a)	+ 8·5	+ 5·5	− 0·6	− 6·7	+ 4·3	− 4·3	−10·4	− 9·8	− 3·2	− 1·4	+ 4·1	+ 6·6
(b)	+ 3·9	+ 6·8	+ 3·8	− 3·5	+ 1·3	− 2·4	+ 0·2	+ 1·7	+ 0·0	− 4·0	− 2·0	+ 2·0
'00– (a)	+13·0	+ 4·9	− 0·5	− 2·8	+ 3·5	− 0·1	− 8·3	−10·1	− 6·0	+ 1·5	+ 4·3	+ 5·0
(b)	+ 8·3	+ 5·9	+ 2·9	− 0·9	− 1·3	+ 0·1	+ 1·3	+ 1·6	+ 2·0	+ 0·2	− 6·6	− 8·6
'05– (a)	+ 6·9	+ 4·0	− 3·2	− 3·1	+ 2·4	− 1·0	− 8·7	− 8·1	− 4·0	+ 1·8	+ 8·2	+ 8·2
(b)	+ 3·0	+ 4·8	− 0·4	− 2·3	− 4·1	− 2·8	− 1·1	+ 2·9	+ 4·2	+ 2·3	− 2·8	−12·2
'10– (a)	+ 6·7	− 0·2	+ 0·6	− 4·4	+ 4·8	+ 0·5	− 3·9	− 2·3	+ 1·6	+ 9·0	+14·7	+16·9
(b)	+ 3·8	+ 1·0	+ 3·1	− 4·6	− 3·3	− 3·6	+ 1·6	+ 7·0	+ 9·3	+10·2	+ 4·6	+ 5·3
'915– (a)	+41·3	+20·0	+ 9·0	+ 3·2	+13·9	+ 8·7	0	0	+ 7·3	+10·0	+15·3	+15·6
(b)	+39·1	+22·2	+11·8	+ 2·4	+ 3·6	+ 2·3	+ 3·1	+ 6·6	+12·9	+ 9·6	+ 5·5	− 5·9
'20– (a)	−13·7	−16·8	−14·9	−10·3	+ 3·0	+ 2·7	− 2·0	+ 0·2	+ 4·3	+13·9	+18·4	+21·0
(b)	−13·7	−14·3	−12·3	−11·3	− 7·3	− 5·0	− 1·2	+ 3·9	+ 6·7	+10·9	+ 6·8	− 1·3
'25– (a)	−15·4	−21·4	−18·8	− 7·9	+10·1	+ 6·8	+ 3·5	+ 7·1	+11·7	+22·2	+27·2	+29·8
(b)	−13·7	−17·9	−15·7	− 8·9	+ 1·6	− 2·6	+ 2·0	+ 8·2	+10·8	+15·5	+12·1	+ 4·2

The differences between the theoretical values and the original values have been expressed as percentages of the theoretical values in each case. For comparison, the same computations have been made on the graduations given by Cramèr and Wold, *loc. cit.*, p. 219 (the graduation by generations). The two sets of figures are given in Table IX.

Some of the differences between the theoretical values and the observed values are considerable. The greatest percentage differences occur for the rate for those aged $32\frac{1}{2}$ for the period 1915–19, 41·3 in my series and 39·1 in that of Cramèr and Wold, and for those aged $77\frac{1}{2}$ for the period 1805–09, 39·5 in the series of Cramèr and Wold. The distributions of the percentage differences are given in Table X.

TABLE X

Distribution of percentage differences in Table IX

Percentage Differences						Rhodes	Cramèr and Wold
−25 and greater than −20			...	...	...	5	2
−20 „ „ −15			...	...	...	9	7
−15 „ „ −10			...	...	...	26	16
−10 „ „ − 5			...	...	...	46	28
− 5 „ „ 0			...	...	...	67	74
0 and less than 5			...	...	...	73	79
5 „ „ 10			...	...	...	38	49
10 „ „ 15			...	...	...	24	25
15 „ „ 20			...	...	...	15	17
20 „ „ 25			...	...	...	3	4
25 „ „ 30			...	...	...	2	7
30 „ „ 35			...	...	...	2	1
35 „ „ 40			...	...	...	1	3
40 „ „ 45			...	...	...	1	—
Total						312	312
Average						+0·61	+2·69
S.D.						9·95	9·77
Average percentage difference neglecting signs ...						7·70	7·58

There is not a great deal of difference between these two distributions. The graduation of Cramèr and Wold is slightly better than that obtained by the methods discussed in the present paper, judged by a comparison of these distributions. But we may conclude that the present method gives results which show that the method is as reasonable as the method of graduation by generations used by the Swedish authors.

Table IX shows, for many years, systematic deviations of the observed rates from those given by the formulæ. For the period

1805–09 and the period 1865–69, both sets of differences (mine and the Swedish authors') are positive. For the period 1820–24, both sets of differences are negative. For the period 1830–34, the differences of Cramèr and Wold are all positive. A more detailed examination reveals some evidence of fairly regular up and down movements in the percentage differences of individual ages as time progresses. As the main purpose of this paper was to find evidence that the mortality rates could conveniently be considered to vary with age and time according to the formula $\mu(y, t) = Q(y) \cdot R(y - t)$ no further examination of the data will be made.

Judged from the results of the present paper it seems reasonable to suppose that this formula will serve as a useful approximation for the mortality rates for females for England and Wales for ages 10 and upwards and for Swedish females for ages 30 and upwards.

IV

Returning now to our original problem of finding the results of integrating

$$\int_0^x q(y, t - x + y)dy,$$

let us assume that $q(y, t) = Q(y)R(y - t)$.

It is probable that this assumption is satisfactory for ages over 10 and dubious for ages below 10.

Our integral becomes

$$Q(y)R(x - t)dy$$

$$= R(x - t)\int_0^x Q(y)dy.$$

If we write $Q(y) = -\dfrac{d}{dy}(\log l(y))$, where $l(0) = 1$.

Then the integral is $- R(x - t) \log l(x)$.

Our function $s(x, t) = e^{R(x - t) \log l(x)} = (l(x))^{R(x - t)}$.

Thus
$$P(t) = \int_0^A B(t - x)(l(x))^{R(x - t)}dx.$$

This formula replaces the familiar formula with which we started

$$P(t) = \int_0^A B(t - x)l(x)\,dx,$$

which is only appropriate when mortality conditions are unchanging.

Discussion of the new formula will be reserved for the future.

DISCUSSION ON DR. RHODES'S PAPER

PROFESSOR M. GREENWOOD : Dr. Rhodes's paper is of interest
from several points of view. In the first place, there is the intel-
lectual interest of generalizing Lotka's equation. On pp. 16 and 32–3
we are shown that, if we may accept the suggestion of Kermack,
McKendrick and McKinlay that the force of mortality at secular
time t for age x is a product of two functions, one a function of x
only the other a function of $(x - t)$, then $l(x)$ of the fundamental
equation is replaced by $l(x)^{R(x-t)}$, where the exponent is the function
of $x - t$. Algebraical analysis of the result is postponed. We may
at least admire the simplicity and neatness of the reasoning.

In the next place, Dr. Rhodes has made a systematic study of
$R(x - t)$ on the reasonable assumption of a logistic form. To this
he has devoted most of his labour and his work is far more thorough
than mine. On page 23 he does me far more than justice. A
casual reader might infer from his comparative table and comment
that my logistic graduations of period mortality were more successful
than his applications of the generation method. That inference is
unfair to Dr. Rhodes. I did not attempt a systematic graduation,
but simply made a few experiments. Whether, as I said in my
address, a systematic graduation of period mortality for all values
of x by logistics, fitted by a more efficient method than trial and
error, would produce a good result, has not been tested. I am
rather sceptical. Even in the age range I examined, males aged
55–65 were treated by a splitting into two periods which was very
arbitrary.

Indeed, all I should feel justified in claiming is that, so far as
concerns the generation method, the very simple plan of using it
arithmetically, proposed by Kermack, McKendrick and McKinlay
in their first paper and adopted by me, gives results not significantly
different from those reached by Dr. Rhodes. His re-examination
of the material does not, I think, modify the conclusions reached by
Cramèr and Wold and by me, viz. that it is not possible to say
decisively whether, from the point of view of graduation, a genera-
tion or a period method is the better. But that is not a fundamental
question. No doubt, if the graduations were very bad indeed, we
should be justified in discarding the hypothesis upon which they
were based. But if, although bad from the point of view of, say, a
rigorous test of goodness of fit, they did not seriously distort the
"facts," and if the hypothesis were biologically reasonable and had
algebraical advantages, then we might well retain it.

But, apart from the intellectual interest of neatly solving a
proposed equation (by no means a despicable object, in these times
when we are all driven in upon our intellectual reasources), one
cannot altogether dismiss a lurking hope that we may, on these
lines, reach a method of long-distance forecasting, be really able to
"look into the seeds of time and tell which seed will grow and
which will not." I do not think that graduations even better than
those Dr. Rhodes has reached would justify the hope. Let me
illustrate the point. Reading this paper led me (perhaps an example

of the habit of a dog as described in Holy Writ) to make another crude experiment with guessed logistics. I took the quinquennial rates of mortality at ages 0–5 (females). From 1841 to the end of the century these rates hardly changed; in 1841–5 the rate was 58·6 per 1,000, in 1870–5 65·0, in 1895–1900 52·8. Since the turn of the century the fall has been great; in 1930–5 the figures was 16·0.

I made two guesses, (1) that the asymptotic values were 65 per 1,000 and 10 per 1,000; (2) that they were 70 and 5. Both give the same point of inflection and the value of the rate for 1905–10, 38·0, is near enough to 37·5. Determining the third constant of the logistic so as to make the curve pass through the observed value, 16·0, for 1930–35, one has the following graduations for 8 values adjacent to the point of inflection.

Quinquennium			Observed	1st Logistic	2nd Logistic
1885–90	...	...	52·0	56·4	55·8
1890–95	...	...	52·8	52·8	51·9
1895–1900	...	...	52·7	48·4	47·5
1900–05	...	...	45·8	43·2	42·6
1905–10	...	...		(Point of inflection)	
1910–15	...	...	34·0	31·8	32·4
1915–20	...	...	28·4	26·6	27·5
1920–25	...	...	21·2	22·2	23·1
1925–30	...	...	18·5	18·6	19·2

These are not wildly absurd graduations, and I have no doubt that further manipulations (which I dare say I may attempt some evening after " black-out ") would improve them considerably, and they are very much alike, although the rate of mortality of the millennium for one is double that of the other. When by further trial a " best " result is reached, and if that " best " result is really good, would one be justified in thinking that the postulated millenial result is correct? My answer would be an emphatic " No."

There is, however, comfort in the thought that when rates of mortality are as low as they now are for the ages which cover the bulk of a population, quite large errors in their determination will not produce such changes in $l(x)$ as greatly to disturb the value of $P(t)$. A cynic might retort that, since this is so, one need not bother to make $l(x)$ a function of t, but simply make two calculations using for one a contemporaneous table of mortality and for the other an optimistic improvement of it. The " truth " will be between the two results and the results may not differ much. That, however, is another story.

I conclude by thanking Dr. Rhodes for some pleasant hours.

Dr. J. O. Irwin : Let us consider a table of mortality in which each row represents an age-group and each column a secular period of time; three methods of graduation are, of course, open to us. We may graduate the rows, the columns, or the diagonals, subsequently perhaps graduating the constants of the curves obtained. If we graduate a row we are graduating the rates for groups of people, all groups of the same age, at different epochs. If we

graduate a column we are graduating the rates for different age-groups at the same epoch. If we graduate a diagonal we are graduating the rates at different ages for a set of people all *born* in the same time interval. Any of these methods may be used without any particular theory of mortality. Cramèr and Wold used both the second and third methods. Professor Greenwood, in his vale-dictory address to the Society in 1936, considered all three. The first is the ordinary problem of graduating a life table; for the second Cramèr and Wold used Makeham–Gompertz curves; for the third Greenwood used logistics. In all three methods there is little claim that any biological law of mortality is being used; the graduation formulæ adopted are simply regarded as convenient. It has been claimed that the Makeham–Gompertz formula represents a biological law, but this claim has been examined and rightly dismissed by Greenwood.

The special interest of Kermack, McKendrick and McKinlay's hypothesis seems to me to lie in the fact that if it is true it does represent something like a biological law. The rate of mortality is the product of two factors, one corresponding to the age and the other to the year of birth. If this were true it would be a " bio-logical law " of great importance, and its detailed investigation is certainly worth while. The main importance of Dr. Rhodes's paper seems to me to lie in the fact that he compares the observed and expected death rates on this hypothesis more fully than has been done hitherto. He does not claim that it represents the whole truth, but thinks there is enough truth in it to make the method useful. His graduation is no better than that of Cramèr and Wold; thus we may legitimately doubt whether the hypothesis of the three co-authors is in fact a law of nature. I do not know how this could be established when other methods of graduation not based on it give equally good results.

Another merit of Dr. Rhodes's paper seems to be its extreme lucidity, and he is to be congratulated on a piece of work done away from his base in war time conditions without, as I understand, even the use of a calculating machine.

Dr. Percy Stocks : Derrick's happy observation in 1927 that each generation tends to carry with it throughout its life a char-acteristic mortality, confirmed as it has been by other statisticians, has opened up interesting fields of study. The time seems to be coming, indeed, when the Registrar-General's annual survey will not be complete without some record of the progress of particular vintages of children. In the Review for 1934 (pp. 28–34) it was shown, for example, that winter-born children are at a disadvantage during their early years over those born in summer because they experience the harder conditions of each successive winter at an age half a year younger. Now that population forecasting is no longer merely an interesting exercise, but is becoming a necessity for the framing of social legislation, some agreed method of fore-casting death rates at given ages is needed. Most writers on the problem of future populations have hitherto avoided the difficulty

by assuming that the death rates will remain at their present levels. This course was not followed, however, by the Registrars-General of England and Wales and Scotland in preparing the forecast populations of Great Britain published in the Report of the Royal Commission on the Distribution of the Industrial Population (p. 141), for one of their assumptions was that mortality rates will continue to fall, since "they can find no justification for the assumption implied in some population forecasts that the most probable course of mortality is one which shows no significant improvement on the rates actually experienced in recent years." But the future values of $\mu\ (y,\ t)$ have, so far, been estimated by freehand graphic extrapolation of the generation curves. If satisfactory mathematical formulæ could be established for this purpose, their use would have advantages, and Dr. Rhodes has set himself to such a task with great ingenuity, and his paper instils the hope that some useful solution may eventually be found. The danger of presenting a simple formula which represents the facts up to, say, 1930, and leaving it there, is that it may be seized upon by population forecasters, extrapolated to infinity and the literature burdened with more forecasts based on untenable hypotheses. An excuse for this might be found in Dr. Rhodes's application of his formula to the period 1951–55, and I have, therefore, compared the extrapolates of $\mu\ (y,\ t)$ for females given by the formula with the mean annual death rates actually experienced in the two periods 1931–35 and 1936–38.

	$y =$	30	40	50	60	70	80
1931–35							
Formula		3·19	4·19	6·95	14·97	38·66	105·0
Actual		3·10	4·32	7·94	16·90	43·04	109·7
1936–38							
Formula		3·13	4·03	6·48	13·62	35·18	98·1
Actual		2·68	3·80	7·36	16·12	41·70	106·3

Considering these in conjunction with Table IV, it is apparent that the fall in death rates since 1921–25 at ages after 45 has not been as rapid as that which would result from the formula, and its use for forecasting would lead, almost certainly, to considerable over-estimation of populations after middle age. Indeed, the social situation envisaged if mortality after 55 were to fall in accord with the formula will not bear pondering over. Let us hope that Providence will be kinder than the formula. Extrapolation of $\mu\ (y,t)$ by freehand graphs leads to death rates at 65–75 and 75–85 in 1951–55, which exceed those in Dr. Rhodes's table by about a quarter and a third respectively, and until the mathematical method has been further developed the former still seems to be the method of choice for forecasting.

Mr. G. J. Lidstone : The author has followed precedent in representing $R(0)$ by a logistic curve which he found "fairly easy"

to fit, and it would be interesting to learn whether he adopted Cramèr's fitting process. The fit seems very good, and it is remarkable that though the curve is based on partial data, which show a definite rising trend throughout, it nevertheless curls over rapidly to an asymptotic part closely representing the excluded data; while if extended in the negative direction (where no data exist but the curve is important for forecasting purposes) it rapidly runs towards the reasonable asymptote $R = \cdot 304$. The logistic form

$$R(\theta) = (A + Be^{-\tau\theta})/(1 + e^{-\tau\theta})$$

(with origin at the point of inflexion) can be expressed as

$$\tfrac{1}{2}(A + B) + \tfrac{1}{2}(B - A) \tanh \tfrac{1}{2}\tau\theta$$

or say $\quad\quad A' + B' \tanh \rho\theta \quad\quad$ (asymptotes $A' \pm B'$)

which is convenient for calculation since there are good tables of tan θ. This form suggests an alternative curve of the same general form but different curvature, viz.

$$A + B \tan^{-1}\tau\theta \quad \text{(asymptotes } A \pm \tfrac{1}{2}\pi B)$$

which might on occasion be a useful variant.

The logistic curve is of the general character of a reversed ogival curve. This suggests another alternative form,

$$A + \frac{B}{\sigma\sqrt{2\pi}} \int_{-\infty} e^{-x^2/\sigma^2} \, dx \quad \text{(asymptotes } A \text{ and } A + B)$$

This should not be difficult to fit, but as the distribution is incomplete logs. must be used (cf. K. Pearson, *Biometrika*, Vol. II, pp. 1–6).

All the above forms (including the commonly used logistic) suffer from the defect that the curves break into halves which are negative images of each other, *i.e.* (still taking the point of inflexion as origin)

$$R(\theta) - R(o) = R(o) - R(-\theta)$$

and $\quad\quad\quad\quad dR(\theta)/d\theta = dR(-\theta)/d\theta$

There seems no reason to think that in general this property belongs to the data, and to force it on the data may result in a considerable degree of misfit : this may possibly account for the difficulty encountered by Greenwood (*J.S.S.*, Vol. 99, p. 701). The misfit may be specially important as influencing the extrapolation of the curve on the negative side for forecasting. Greater freedom and consequent better fit may be secured when required by basing the curve on the ogive of a more general cocked-hat distribution (possibly skew), $y = \phi(x)$: this would lead to the form

$$A + B \int_{-\infty}^{\theta} \phi(x) dx \quad \text{(asymptotes } A \text{ and } A + B).$$

Fitting should be practicable, although the distribution is incomplete, if some form of the translation-method were adopted.

Mr. C. D. Rich : The improvement in mortality which has occurred over a period of 90 years is shown clearly in Table I. The

fact that there has been a large decline in the rate of mortality at the younger ages but only a relatively small one at the older ages has led some people to believe in a theory of " suspended mortality "; it has been argued that the advancement of medical science has resulted in a proportion of inferior lives surviving to older ages when they become subject to heavy mortality. Dr. Rhodes's figures show the fallacy in this argument; the truth is that the lives which have experienced the low rates of mortality at the younger ages have not yet attained the older ages. The run of the figures supports the " generation theory "; according to the assumption of the paper, just as the mortality at age 30 of persons born in 1897 was one-third that at the same age of persons born in 1812, so the mortality at age 80 of the former will be one-third of that experienced at age 80 by the latter.

The good fit obtained by means of the logistic curve in Fig. 1 and Table II is an example of its usefulness in connexion with mortality and population statistics. This curve, which has been used by Dr. A. J. Lotka in many of his writings, provides a method of smooth transition from one level to another, in our case from a relatively high mortality experience to a relatively low one. It is not unreasonable to suppose that at the commencement of the period under review the conditions of life and the mortality of the population had for some time been more or less stationary. A change in conditions, due to improvements in social habits and medical science, resulted in a decline in mortality which took effect first gradually and then more rapidly. The decline now appears to be slowing up and the mortality to be approaching a new stationary level.

It is interesting to note that the point of inflexion of the logistic curve, $\theta = -20$, corresponds to a date of birth $1862\frac{1}{2}$, or attainment of middle age (say 40) in 1902. We are thus now considerably more than half way through the movement (in fact just over three-quarters way through if we assume it commenced say at $\theta = 50$). A question which naturally gives rise to speculation is whether the mortality will continue on its smooth course to the level represented by $+\infty$ in the table at the top of page 24, or whether before that happens some new change will take place so starting the mortality off on a fresh curve to some other level.

Dr. W. O. KERMACK and LT.-COL. A. G. McKENDRICK : The data which are analysed by Dr. Rhodes have been examined by Dr. McKinlay and ourselves in the two papers to which the author refers. We showed there that the specific mortality rates for Scotland and for England and Wales (excluding children under five) could be approximately expressed as the product of two factors, α and β, where α is a function only of the date of birth and β is a function only of the age of the group in question. These factors α and β correspond exactly, apart from an arbitrary multiplying factor, to the $R(y - t)$ and $Q(y)$ of Dr. Rhodes. The method of evaluating these factors used by the author differs in detail from both the methods used by us in our papers, but the general idea is

the same. It is of interest to compare the figures obtained by Dr. Rhodes and by our second method, which we regard as more refined than our first. The existence of the arbitrary constant interferes with simple direct comparison, but in our second paper we suggested a method of normalization to overcome this difficulty. This consists in fixing the constant so that the product of the β values is unity. The following tables give the figures for English females normalized over the age-groups common to both series, namely 20–70 years inclusive. (The 20-year value in Dr. Rhodes's series is derived from the simple average of the $17\frac{1}{2}$- and $22\frac{1}{2}$-year values.) Similarly the normalized α values from Rhodes's figures have been obtained by averaging the two 5-yearly periods corresponding to the 10-yearly period centred round the given date.

Comparison of Normalized β (or Q(y)) Values.

Age	20	30	40	50	60	70
Rhodes	0·476	0·571	0·710	0·939	1·640	3·396
K. M. and M. ...	0·486	0·568	0·705	0·933	1·599	3·441

Comparison of Normalized α (or R(y − t)) Values.

Year of Birth	1765	1775	1785	1795	1805	1815	1825	1835	1845	1855	1865	1875	1885	1895
Rhodes	17·52	17·52	17·42	17·30	16·97	17·42	17·18	16·43	14·89	13·19	10·53	8·88	7·48	6·04
K. M. & M.	18·10	17·90	17·49	17·29	17·29	17·19	17·07	16·25	15·02	13·17	10·91	8·61	6·79	6·18

It will be seen that the results are in substantial agreement, as of course is to be expected in view of the essential similarity of the methods of derivation.

The author has shown that the series of $R(0)/R(30)$ values obtained for England and Wales and for Sweden can be approximated to by means of a logistic curve. For the purpose of graduating the data, these logistic formulæ are doubtless very convenient. The author very properly avoids attaching any theoretical significance to them and, indeed, points out that the Swedish figures might be equally well represented by a straight line. It would clearly be highly dangerous to use the formulæ for the purpose of extrapolating into the future, and in particular we should not be justified in considering the value given by $\theta = -\alpha$ as the limit which α will ultimately reach.

We have already suggested that the α curve may be regarded as reflecting the effect of the environment on the generation in question, whilst the β curve represents the inherent vitality of the human organism. The environment must largely exert its effect in childhood, probably before the age of 10, for effects exerted after this age would presumably cumulatively reinforce those already there, and this would result in the value of α not being constant for the generation, but falling throughout its course. If these later environmental influences do exist, they cannot be detected, and they may be hidden by the influence of selection on children and youths.

The better environment of the present day as compared with the past may allow innately weaker individuals to survive at the younger ages. This would result in a tendency of α to rise as the generation progresses through life. The two suggested influences, the one causing α to fall, the other causing it to rise, would neutralize each other, thus leaving α approximately constant, and determined mainly by the effect of the environment during childhood.

If this interpretation is correct, the course of the $R(0)/R(30)$ (or α) curve shows that environmental conditions were approximately constant in Great Britain until the early part of the nineteenth century, that an improvement then set in, slow at first but afterwards more rapid—an improvement which was still going on during the first quarter of the present century. Clearly, sooner or later this improvement must approach some limit, and from this point of view the approximately logistic trend of the α values is not surprising. However, the trend does not represent some inherent law of progress, but is conditioned by the improvement of social conditions which may be accelerated or retarded by the major events of history.

The case is somewhat different with regard to the $Q(y) . R(30)$ or β values. These are proportional to the death rates which the members of a generation (all those born at one period) experience during the course of their lives, and may be regarded as reflecting the vitality of the human organism at different ages. This vitality, or resistance to disease, is conditioned by the physiological make-up of the organism. We might expect, therefore, that the course of the Q values would follow some relatively simple law. We have shown, in fact, that the values for males in Scotland and in England and Wales are well represented by a Makeham Gompertz formula from the 5–15 group upwards. On the other hand, the β values for females could not be fitted by a similar formula over the whole range because of a flattening in the curve between the ages of 35 and 50, probably associated with the cessation of child-bearing. This is in general agreement with the results of the author, who has dealt with females only, and finds that his formula for the English females fails to agree with the observed values below the age of 30. It is probable that if he applies similar calculation to the male death-rates, he would find agreement in the lower age-groups—always of course excluding the children under 5.

It may be pointed out that the general principle embodied in the formula $\mu(y,t) = R(y - t)Q(y)$ also holds in the case of Scotland for the rural and the town populations separately (see Barclay, Kermack and McKendrick [*]). The α curves obtained for these two groups start at widely different levels, but after following a quasi-logistic course had reached by 1931–35 approximately equality of values; that is to say, though both country and town environments have improved, the town environment, previously so bad, had almost if not quite made up on that of the country.

We observe that the equation finally arrived at in the last para-

* " Comparison of the Specific Mortality Rates in Town and Country Districts of Scotland since 1871," *Journal of Hygiene*, 1940, vol. XL, pp. 423–433.

graph of the paper suffers from one important limitation. As mentioned above, Dr. Rhodes agrees that the equation $\mu(y,t) = Q(y) \cdot R(y - t)$, on which his integral formula is based, holds only for values of y greater than 10. We, too, emphasized in our paper that the fall in the infantile death rate took place more than a generation later than would be expected from the formula.

We encountered a similar difficulty in dealing with equations 22–24 of our second paper, which are, indeed, rather closely related to the equation derived by Dr. Rhodes. How serious this limitation on Dr. Rhodes's equation may be, will depend on the purpose for which the equation is employed, and we note with interest that Dr. Rhodes promises to discuss the new formula in a future communication. It may be noted, however, that the formula may be put in the more accurate form $P(t) - P'(t) = \int_{10}^{A} B'(t - x)l'(x)^{(Rx - t)}dx$, where $P'(t)$ is the number in the population under 10, $B'(t - x) = B(t - x)e^{-\int_{0}^{10} \mu(yt - x + y)dy}$ and $l'(x) = e^{-\int_{10}^{x} Q(y)dy}$. Here the product form for $\mu(y - t)$ is assumed only for values of y greater than 10. Physically this formula is equivalent to excluding members of the population less than 10 years of age, and modifying the birth rate so as to allow for deaths sustained by children before they enter the population under consideration at their tenth year.

Dr. Rhodes, in reply : There is very little I can say in reply to the various comments on the paper. The Society is indebted to the various writers for finding time to read it through in these arduous days. I felt that I was merely extending the work of others with the object of expressing in a fairly simple mathematical form the unknown function $\mu(y,t)$. I believe that the logistic function is a very useful function and that its value in the present instance is to serve as an indicator. But I quite agree with Dr. Lidstone that it may in fact be too simple, its symmetry may be unnatural here. I hope no one will use my results for extrapolation purposes. I think that all trained statisticians and actuaries realize the dangers of extrapolation. I gave an instance of extrapolation in order to present a picture of a possible course of events, but I quite agree with Dr. Stocks that the particular curve I obtained may not accurately represent the facts of the picture. His reference to freehand graphs reminds me of a serial discussion to be found in the *Journal of the Institute of Actuaries* of about 100 years ago between an advocate of graphical methods of interpolation and an advocate of arithmetical methods.

I have already been dallying with the formula with which I finished the present work, and have realized that one could confine oneself to populations aged 10 and over. I am glad to see that Dr. Kermack and Colonel McKendrick suggest this also.

MISCELLANEA

CONTENTS

THE EFFECT OF THE ELIMINATION OF TREND ON OSCILLATIONS IN TIME-SERIES

By M. G. KENDALL

1. A TIME-SERIES usually exhibits to a greater or less degree three main features: (1) a trend, or "secular" movement; (2) oscillations * of some regularity about this trend; and (3) casual or random fluctuations.   One of the principal problems in the analysis of such a series is the isolation of these three constituents for separate study; and the first factor which falls for isolation is the trend.

The concept of "trend," like that of time itself, is one of those ideas which are generally understood but difficult to define with exactitude.   A movement which has the evolutionary appearance of a trend over a period of thirty or forty years may in reality be one phase of an oscillatory movement of greater extent.   A good deal depends on the length of the series under consideration whether we regard any particular tendency in the series as a trend, or long-term movement, or an oscillation, or short-term movement.   But in any case we require of a trend curve that it shall exhibit only the general direction of the time-series, and in practice this amounts to saying that it must be representable, at least locally, by a smooth non-periodic function such as a polynomial or a logistic curve.

2. In recent years the mathematics of trend fitting have been brought to an advanced stage of development.   There are various methods advocated by different writers for different purposes; but, putting aside graphical methods, which involve personal judgment and cannot claim serious attention for theoretical work, they all depend on one of two processes: either (a) a polynomial of chosen degree is fitted to the whole series, almost invariably by least squares; or (b) a moving average of chosen extent and with chosen weights is used to determine trend values at different points of the series.   The

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* I follow Udny Yule (1921) in using the word "oscillation" instead of the more usual word "cycle."   The latter, strictly speaking, implies a regularity of period which is rarely found in time-series.   A good deal of the argument whether the trade "cycle" exists or not seems to me to depend on disagreement about the meaning of the word.

weights are usually selected to ensure that a polynomial of pre-determined degree shall represent the series *locally*.

In practice the method of moving averages has decisive advantages over the fitting of a curve to the whole series. For one thing, a curve of sufficient flexibility to give an adequate fit to many time-series must be of high degree and will involve laborious arithmetic and considerable uncertainty in the stability of the resulting formula. What seems fatal to the extended practical use of the method (*a*), however, is the fact that if extra members are added to the series the calculations for a curve including these new data have to begin almost *ab initio*; so that if, as very frequently happens, one wishes to bring one's work up to date the arithmetic has nearly all to be done afresh.

3. It seems, therefore, that until a better method has been found, there is no choice but to use some variant involving moving averages. A thorough account of the different possibilities has been given by Sasuly (1934). The principal interest in the work which has led up to our present knowledge of the subject seems to have been the study of trend itself, not the elimination of trend in order that attention may be concentrated on the residual oscillations. In consequence some effects of the moving-average method on these residuals are in danger of escaping notice; and the object of this paper is to bring them into greater prominence.

4. Suppose we have a time-series $\phi(t)$ defined for integral values of the variable t, and let

$$\phi(t) = \phi_1(t) + \phi_2(t) + \phi_3(t) \quad . \quad . \quad . \quad (1)$$

where ϕ_1 represents the trend, ϕ_2 the oscillatory part and ϕ_3 the residual attributable to casual fluctuations. The method of moving averages consists of taking the weighted average of each set of p consecutive terms of ϕ and assigning this average to be the trend value at some point on the range covered by the p values, usually the middle point, so that it is generally convenient to take p odd. The value of p and the weights employed are determined by the accuracy desired. The ideal would be to find weights which, when applied to a range of p consecutive values of ϕ_1, reproduce the value of ϕ_1 at the middle point of the range wherever that range was situated on the curve ϕ_1; in other words, the trend of ϕ_1 ought to be ϕ_1 itself. Without prior knowledge of ϕ_1 it is impossible to determine a moving average which can be guaranteed to do this; but it is possible to find weights which will reproduce a parabola of any required order and a moving average based on them will give satisfactory results if ϕ_1 can be approximated locally by such a parabola. We may even take the trend to be defined by this property.

Consider then the optimum case in which the moving average does reproduce the trend curve exactly.   Denote by T the operation of taking a moving average.   Then from (1) we have

$$T\phi = T\phi_1 + T\phi_2 + T\phi_3 \quad . \quad . \quad . \quad . \quad (2)$$

and on subtracting this expression from (1) " to eliminate trend," we get

$$\phi - T\phi = \phi_2 + \phi_3 - T\phi_2 - T\phi_3 \quad . \quad . \quad . \quad (3)$$

ϕ_1 and $T\phi_1$ being equal by hypothesis.

It is $\phi - T\phi$ which we study when considering oscillatory movements; and the point to be emphasized is that the existence of the terms $T\phi_2$ and $T\phi_3$ in (3) may introduce oscillatory terms which were not, or annihilate oscillatory terms which were, in the original ϕ. That is to say, the method of moving averages may induce into the data oscillations which are entirely spurious or may reduce or remove oscillations which are entirely genuine.

5. Consider first of all the effect of moving averages on the residuals ϕ_3.   To simplify the discussion I will consider the simplest kind of moving average, namely the arithmetic mean of p values centred at the point concerned, and will suppose that the residuals are the components of a random variable with variance Γ.   Writing $\xi_j^{(1)}$ for the component at t_j we have for the moving average at that point, say $\xi_j^{(2)}$

$$\xi_j^{(2)} = \frac{1}{p} \sum_{k=-[p/2]}^{[p/2]} \xi_{j+k}^{(1)} \quad . \quad . \quad . \quad . \quad (4)$$

where $[p/2]$ is the integral part of $p/2$.   Consecutive values of $\xi^{(1)}$ are independent but consecutive values of $\xi^{(2)}$ are not.   In fact $\xi_j^{(2)}$ and $\xi_{j+k}^{(2)}$ have $p - k$ values of $\xi^{(1)}$ in common and will be correlated if $p > k$.   Whereas $\xi^{(1)}$ was a random series $\xi^{(2)}$ will be much smoother; and if we proceed to take moving averages of $\xi^{(2)}$, resulting say in $\xi^{(3)}$ we shall get a smoother series still.

This effect has been considered at length by Yule (1921) and Slutzky (1937).   One does not have to repeat the averaging many times before the resulting series becomes very smooth and presents to the eye just those features which are characteristic of oscillatory time-series—fluctuations with varying amplitude and phase, the periods (peak to peak or trough to trough) being distributed with central tendency about some modal value.*   Slutzky's main concern in dealing with this subject was to show that effects resembling trade fluctuations can be generated by the additive action of purely random causes.   For the present purpose it is considered from a different

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* Slutzky establishes this last result empirically.   It has not yet been demonstrated as a mathematical theorem; but it has been confirmed by Dodd (1939) and by experiments of my own on random numbers.   For the parallel phenomenon in trade cycles see Mitchell (1927).

point of view—the generation of spurious oscillatory movements in the residual $\phi - T\phi$ owing to the term $T\phi_3$.

6. Dodd (1939) has recently made a useful contribution to this subject by considering the periods of oscillations generated by moving averages. If we have a set of variables ξ which are independent and normally distributed about zero with variance v the probability that

$$y_p = \sum_{j=1}^{p} a_j \xi_j < 0 \quad \ldots \quad \ldots \quad (5)$$

and

$$y_{p+1} = \sum_{j=1}^{p} a_j \xi_{j+1} > 0 \quad \ldots \quad \ldots \quad (6)$$

i.e., that the generated series changes sign from negative to positive, is the proportional frequency of

$$dF = \frac{1}{(2\pi)^{\frac{p+1}{2}}} exp - \frac{1}{2v} \left(\sum_{j=1}^{p+1} \xi_j^2 \right) d\xi_1 \ldots d\xi_{p+1}$$

in $(p + 1)$ dimensions between the planes (5) and (6). This is evidently equal to θ, the angle between the two planes, which is given by

$$\cos \theta = \frac{\Sigma(a_j a_j + 1)}{\Sigma(a_j)^2} \quad \ldots \quad \ldots \quad (7)$$

Thus the mean distance from one " upcross " to the next is $2\pi/\theta$.

Similarly, the probability that

$$\Delta y_p = y_{p+1} - y_p < 0 \quad \ldots \quad \ldots \quad (8)$$

and

$$\Delta y_{p-1} > 0 \quad \ldots \quad \ldots \quad (9)$$

is the angle between these two planes, say θ_1, and thus the mean distance from peak to peak is $2\pi, \theta_1$.

Dodd also considers the elimination of minor oscillations or " ripples." If in addition to the conditions (8) and (9) we also require that

$$y_p > y_{p-k} \quad \ldots \quad \ldots \quad (10)$$

where k is some arbitrarily chosen number, the probability of (8), (9), and (10) being satisfied simultaneously is the area on the unit three dimensional sphere cut off by these three planes. If the angles between pairs of planes are A, B, C, this is equal to $A + B + C - 2\pi = \theta_2$, say. Hence the probability of the conditioned maximum is $\theta_2/4\pi$ and the reciprocal is the mean distance between maxima, ripples excepted.

Dodd supports his conclusions with some experimental material derived by the application of some well-known graduation formulæ to *rectangular* material. The agreement is good, and suggests that the results of the theory are applicable to other than normal random variation.

7. What we define as the "length" of an oscillation is to some extent arbitrary, but Dodd's results allow a certain freedom of choice. A minimum would seem to be a mean distance from peak to peak, i.e., $2\pi/\theta_1$. A maximum would be the mean distance from upcross to upcross, i.e., $2\pi/\theta$. To obtain greater precision within these limits we need to decide what is to be regarded as a ripple, and it looks as if every case would have to be settled on its merits.

8. Consider now the amplitude of the induced oscillations in $T\phi_3$. Since $\xi^{(2)}$ is the sum of p independent random variables it will have a variance V/p. $\xi^{(3)}$ is the sum of p correlated variables and the expressions for its variance are more complicated.

It will be evident on a little reflection that if a simple moving average of extent p is iterated q times, the result is equivalent to an average of the series with extent $q(p-1)+1$ with weights which are the successive coefficients in $(1 + x + x^2 + \dots x^{p-1})^q$. The variance of $\xi^{(q+1)}$ is therefore the sum of the squares of these coefficients multiplied by V/p^q. Thus

$$\text{var. } (\xi^{(q+1)}) = \frac{V}{p^q} \cdot \text{coeff. of } x^{q(p-1)} \text{ in } (1 + x + x^2 + \dots x^{p-1})^{2q}$$

$$= \frac{V}{p^q} \text{ coeff. of } x^{q(p-1)} \text{ in } \frac{(1 - x^p)^{2q}}{(1 - x)^{2q}} \quad \dots \quad (11)$$

The following table shows the ratio of the variance of $\xi^{(q+1)}$ to V for a few values of p and q.

$q =$ $p =$	1	2	3	4	5
2	0·33	0 23	0·19	0·17	0·15
4	0·25	0·17	0·14	0·12	0·11
5	0·20	0·14	0·11	0·10	0·09
6	0·17	0·11	0·09	0·08	0·07
7	0·14	0·10	0·08	0 07	0·06

The variance of the series derived from $\xi^{(1)}$ is reduced very considerably by the first averaging but less so by subsequent averagings, and this is what we might expect from the correlations between members of the series. For example, when $p = 7$, the first averaging reduced the variance by $\frac{1}{7}$, whereas the next four averagings reduce it only by little more than a further $\frac{1}{2}$.

9. The general inference is that the oscillatory movements in $T\phi_3$ will be small compared with the random fluctuations of ϕ_3 itself if p is large. But it is important to realize that they are not on that account negligible. For example a periodogram analysis of ϕ_3 will reveal no periodicities whereas one of $T\phi_3$ may and probably will.

To reduce the effect of $T\phi_3$ as much as possible it is desirable to

make p large, and if both p and q are at our disposal, it will be more use extending p than iterating to increase q. In other words, for a given total weight the individual weights should be as small and as equal as possible, as is otherwise evident from the consideration that in this way their total sums of squares will be minimized.

But unfortunately this requirement runs contrary to the necessities of the weighting to eliminate trend. To fit a moving quartic or sextic, for instance, we require a system of weights which are very far from equal (cf. Sasuly (1934)), and in fact some of the best-known formulæ for trend elimination such as Spencer's 21-point formula (1904) or Macaulay's 43-point formula (1931) use several iterated averages. The weights of Macaulay's formula are

$$\frac{1}{9600} \quad \begin{array}{l} [7,\ 18,\ 30,\ 40,\ 45,\ 28,\ -8,\ -60,\ -122,\ -178,\ -205,\ -190, \\ -127,\ -6,\ 163,\ 360,\ 562,\ 760,\ 928,\ 1050,\ 1127,\ 1156, \\ 1127\ .\ .\ .7] \end{array}$$

and if applied to a random series would reduce the variance to about 0·11 of its original value, *i.e.*, about as much as a simple average of nines.

10. Consider now the effect of the moving average method on ϕ_2 the genuinely oscillatory part of the original series. Yule (1921) has already discussed a similar problem from a different point of view, namely the effect of variate differencing on harmonic series. Consider the simple case when the oscillatory part is a sine term $\sin(\alpha + \lambda t)$, t being in our convention an integer. Since

$$\sum_{j=1}^{p} \sin(\alpha + j\lambda) = \frac{\sin \frac{1}{2}p\lambda}{\sin \frac{1}{2}\lambda} \sin \{\alpha + \frac{1}{2}(p-1)\lambda\}$$

a simple moving average of p consecutive terms centred at the middle term will result in a sine series of the same period and phase as the original, but with amplitude reduced by the factor

$$\frac{1}{p} \frac{\sin \frac{1}{2}p\lambda}{\sin \frac{1}{2}\lambda} \quad . \quad . \quad . \quad . \quad . \quad (12)$$

Iteration q times will reduce the amplitude by the qth power of this factor.

Thus the term $T\phi_2$ will be small if p is large, q is large or if $\frac{1}{2}p\lambda = 0 \pmod{\pi}$, *i.e.*, if the extent of the moving average is a period of the oscillation. But if λ is small and $p\lambda$ is small the amplitude is barely reduced at all, and $\phi_2 - T\phi_2$ will largely disappear, *i.e.*, the moving average will partially obliterate the harmonic term in ϕ_2. In this case, $p\lambda$ being small, the extent of the moving average is small compared with the period of the harmonic, *i.e.*, the oscillation is a very slow one. This result is what we should expect. A slow oscillation is really treated as a trend by the moving average and eliminated accordingly. The moving average will emphasize the shorter

oscillations at the expense of the longer ones. If the moving average is taken over rather more than the time period the moving averages may have the original oscillation with the sign reversed and consequently the difference from the trend may somewhat exaggerate the true oscillations.

11. To sum up : in the study of oscillations obtained from a time-series by eliminating trend with moving averages it is desirable to safeguard against the introduction of spurious effects and the distortion of genuine effects due respectively to the random and oscillatory terms in the original series. This can best be done by extending the moving average so far as possible and by making it approximate to a multiple of any cycles which are suspected to exist. Iteration rapidly reduces the distortion of genuine oscillatory movements, but does not exert such a great effect on the spurious cycles due to random fluctuations.

These considerations support the desirability of extending the moving average as far as possible; but other considerations will work in the reverse direction. The saving of arithmetic; the avoidance of sacrificing terms at the beginning and end of the series; and the nature of the weighting dictated by trend elimination itself are factors of this kind.

12. Some interesting material illustrating the foregoing theory may be drawn from agricultural statistics. I took the sheep population of England and Wales for each of the years 1867 to 1939 and, after some trials of alternative methods, eliminated trend by a simple nine-year moving average. The residuals were as follows :

Year	Residual (000)	Year	Residual (000)	Year	Residual (000)
1871	−176	1893	+ 34	1915	+ 19
72	−112	94	−103	16	+128
73	+ 50	95	−104	17	+ 97
74	+141	96	− 15	18	+ 69
75	+ 60	97	− 23	19	− 29
76	− 20	98	+ 17	20	−174
77	+ 12	99	+ 71	21	−107
78	+ 82	1900	+ 35	22	−142
79	+130	01	+ 16	23	−109
80	− 14	02	− 27	24	− 23
81	−166	03	− 32	25	+ 60
82	−179	04	− 49	26	+121
83	− 84	05	− 61	27	+ 94
84	+ 38	06	− 52	28	− 25
85	+ 97	07	− 24	29	− 90
86	+ 8	08	+ 68	30	− 75
87	− 5	09	+141	31	+ 72
88	−105	10	+119	32	+152
89	− 99	11	+ 66	33	+112
90	+ 35	12	− 52	34	− 64
91	+159	13	−117	35	− 87
92	+167	14	− 61		

This is a fairly typical specimen of the oscillatory movements in English agriculture, though the regularity of the fluctuations is rather better marked than usual for livestock numbers and crop acreages. The alternation of groups of positive and negative signs is alone sufficient to suggest the existence of a cycle of about eight years. The question is, can this apparent oscillatory movement have been induced by the moving average employed? The question may be answered decisively in the negative by two quite distinct approaches.

13. Consider in the first place the period of oscillations induced in random series by a nine-point average. In equation (7) the a's are all equal, so that $\cos \theta = 8/9$, $\theta = 27° 40'$, and the mean distance between upcrosses is about 13. In equation (8) it will be found that $\Delta y_r = x_1 + x_9$, $\Delta y_{r-1} = x_0 + x_8$ so that the angle between the planes so defined is $\pi/2$ and the mean distance between maxima is 4. The mean period of induced oscillations would then be between 4 and 13, probably about 10. This is not different enough from the observed value to dispose of the suggestion that the observed oscillation is spurious.

14. We have then to consider the variance of the series. The variance of the residuals given in the foregoing table in 8,474. If these are generated by averaging a random series that series must have a variance nine times as great, *i.e.*, 76,266. We require for comparison with this the true value of the variance of random elements in the original series.

Such a value may be obtained by finite differences. If we difference the original series (before trend is eliminated) k times, the random element ϕ_3 grows in importance with k at the expense of the systematic elements ϕ_1 and ϕ_2 and the variance of the differenced series will tend to $\binom{2k}{k}$ times that of ϕ_3. The following are the sums of squares of deviations from zero up to $k = 10$ divided by $\binom{2k}{k}$.

	S (deviation)^2 $\binom{2k}{k}$
1	3467
2	1442
3	954
4	629
5	518
6	448
7	401
8	371
9	356
10	347

The ratios are evidently tending to a value in the neighbourhood of 347, and a comparison of this figure with that required by the explanation of generation by a moving average, 76,266, rejects the explanation decisively.

15. An entirely different approach leads to the same conclusions. Yule (1921) has introduced a very fruitful method of dealing with oscillations in time-series by considering the correlations of the members of the series among themselves. If we calculate the product moment correlation between each member of the series and the succeeding member we have the autocorrelation coefficient of order 1, denoted by r_1; generally the correlation between each member and the next but $(k - 1)$ is the autocorrelation of order k, r_k. If a moving average of extent p is taken of a random series the successive terms of the resultant are correlated up to r_p; but within sampling limits $r_k = 0$, $k > p$. If however, there is a harmonic term in the series it will be reproduced in the autocorrelations. Yule's method therefore offers a criterion for distinguishing between the two cases and we can determine whether the oscillations in a series are induced or not by examining whether the autocorrelations decay to zero. The following are the coefficients for the sheep data here considered :

Order of autocorrelation	Coefficient	Order of autocorrelation	Coefficient
1	+0·5952	16	+0·2764
2	−0·1513	17	+0·4394
3	−0·6005	18	+0·2926
4	−0·5372	19	−0·0743
5	−0·1376	20	−0·3589
6	+0·1441	21	−0·3809
7	+0·2028	22	−0·1176
8	+0·1183	23	+0·1728
9	+0·0064	24	+0·3433
10	−0·0779	25	+0·3319
11	−0·1419	26	+0·1536
12	−0·1724	27	−0·2030
13	−0·1857	28	−0·4556
14	−0·1280	29	−0·4150
15	+0·0518	30	−0·1844

The coefficients show no signs of tending to zero and in fact the oscillations are well defined, with a period of between eight and nine years. Whether this evidence is sufficient to establish the existence of a sheep cycle I will not attempt to discuss on the present occasion; but it is clearly sufficient to dispose of the supposition that the oscillations in the series obtained by eliminating trend with a moving average are induced from random fluctuations by the averaging process.

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COST OF LIVING OF THE WORKING CLASSES

IN the issues of the *Ministry of the Labour Gazette* for December 1940 and January 1941 there have been published some results of an enquiry, instituted by the Ministry in 1937 and 1938, into the cost of living of the working classes of Great Britain and Northern Ireland. The enquiry took the form of a collection at quarterly intervals of family budgets detailing the household expenditure in each of four weeks on rent, food, clothing, fuel and light, travelling and miscellaneous items. The aim of the Ministry was to secure budgets from at least 10,000 households and, with this in view, a selection was made of 30,000 adult wage-earners and small-salary earners. The large majority of these were, of course, workpeople compulsorily insured against unemployment, but room was found also for a selection from the principal classes of manual workers, and from non-manual workers with salaries not exceeding £250 a year who were not insured against unemployment (*e.g.*, permanent employees of railways, local authorities, public utility undertakings and Government Departments). The selection was made by the method of random sampling, the required number of names being taken at regular intervals from the registers of adult workers insured against unemployment, and a similar method was employed, so far as possible, in selecting the names of uninsured workers. Some of the workers included in the list were unemployed, but care was taken to exclude cases of long-continued unemployment, *i.e.*, those known to be applicants for " unemployment assistance." As a result, the Ministry was able to obtain, from as many as 8,905 industrial, etc., households, budgets for all the four weeks required (in October 1937 and in January, April and July 1938 respectively), and 1,491 from agricultural households. In addition 2,799 budgets were received from households which did not supply budgets for all the four weeks covered by the enquiry. Measures were taken to ensure that all districts were fairly represented in the sample.

The information obtained from these budgets has been classified under about 100 different headings, and statistics relating to the industrial households were published in the issue of the *Labour Gazette* for December 1940 and those relating to agricultural households in that for January 1941. Results of further analysis of the budgets will appear in future issues.

As regards the budgets from industrial workers, the average number in the household was $3\frac{3}{4}$, of whom $2\frac{1}{2}$ were aged 18 or over and 1 was a child under 14. The average number of wage-earners

was 1¾. In agricultural households the average number of members was but slightly more (3·79 compared with 3·77), 2·39 of whom were 18 and over and 1·14 were children under 14. The number of wage-earners was slightly less (1·59 as compared with 1·75), and only the head of the household was necessarily an agricultural worker.

The average number of rooms occupied by the household was 3·9 in the case of industrial workers and 4·0 in the case of agricultural workers. The kitchen is included in both cases, but sculleries are excluded. In this connection it would be interesting to know how the Ministry has classified the small (the very small) room assigned for kitchen purposes in the vast majority of the smaller houses built during the last twenty years, more especially in London and the surrounding areas. Probably they have been excluded from the count. Even if this is so, the number of rooms per household appears small, and points to an average of two bedrooms only, which on a total income of what must be at least £5 per week seems an unduly low figure, unless in the majority of households there is no other " living-room " except the kitchen, and this can hardly be the case. It should be borne in mind, however, that the sample included single-member households, and if these amounted to any appreciable proportion of the total, they would have some effect on the figures as to the average number of rooms, and, indeed, on practically all the statistics.

The principal interest of the enquiry, and indeed its main object, was to obtain recent and more extensive particulars as to the cost of living of working-class families, with a view to revising, if and where necessary, the monthly statistics published by the Ministry as to the fluctuations in the cost of living, and the predominant prices paid for articles of working-class consumption. The present " index-number of the cost of living," as it is called, has been published monthly since 1914, and the budgets on which the proportionate " weights " were based, and which were less than 2,000 in number, relate to the year 1904, and principally to the expenditure on food. Information as to the cost of other articles of expenditure—*e.g.*, rent, fuel, clothing, etc.—was principally obtained from other sources.*

Before commenting in detail on the statistics as to the weekly expenditure revealed by the new budgets, it will be best to set out briefly the general results as shown by the budgets of those households which furnished information for each of the four selected weeks.

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* See the pamphlet published by the Ministry of Labour in 1931, entitled *The Cost-of-Living Index Number.*

	Weekly expenditure of industrial households	Weekly expenditure of agricultural households	Proportion of Total Expenditure	
			Industrial Households	Agricultural Households
No. of budgets...	8,905	1,491	—	—
Average no. of persons in household...	3·77	3·79	—	—
Average no. of wage-earners...	1·75	1·59	—	—
Average expenditure on :	*s. d.*	*s. d.*	%	%
Rent	10 10	4 9	12·6	8·2
Food	34 1	27 9	39·5	47·9
Clothing	9 4	5 10	10·8	10·1
Fuel and light	6 5	4 11	7·4	8·5
Average expenditure on other items :				
Travelling	2 3	0 10½	2·6	1·5
Tobacco and cigarettes ...	2 6½	1 11	2·9	3·3
Drink (beer and mineral waters, etc.)	0 9¼	0 4¾	0·9	0·7
Holidays	0 7¼	0 1¾	0·8	0·3
National social insurance payments...	2 0¾	1 7¾	2·4	2·8
Insurance premiums, pension funds, etc. ...	2 4½	1 5¼	2·8	2·5
Trade union subscriptions...	1 4¼	0 6¼	1·6	0·9
Doctors' fees, etc., medicines, drugs, etc.... ...	1 8	1 2½	1·9	2·1
Household requisites of all kinds (including furniture)	4 1	2 4	4·7	4·0
Newspapers, books, stationery, postage	1 7½	1 3½	1·9	2·2
Entertainments, games, etc.	1 4½	0 4½	1·6	0·6
Other miscellaneous items...	4 10	2 6¼	5·6	4·4
Total Other Items ...	25 7	14 8	29·7	25·3
	86 3	57 11	100·0	100·0

It will, we think, be a matter of some surprise and of considerable satisfaction that an average industrial working-class household of less than four persons has the wherewithal to spend as much as 86s. 3d. per week, and an agricultural household 57s. 11d. The total average *income* shown by the budgets used for the present index-number was only 36s. 10d. Moreover, the expenditure shown by the new budgets is clearly not complete, for the expenditure of 9¼d. and 4¾d. per week on drink (beer, mineral waters, etc.) by the industrial and agricultural households respectively, and of 7¾d. and 1¾d. on holidays, is clearly an under-estimate. It looks as if it could reasonably be estimated that the average income of the industrial family was at least £5 per week, and that of the agricultural family at least £3 3s. It should be borne in mind that the sample includes households where the head is unemployed, and also cases where the household consists of one individual only—

surely the inclusion of this latter class is the result of an adoption of a technical definition of a household which might well have been avoided. We should like very much to see the results shown by household budgets of unemployed persons, and also of those of persons living alone, but we doubt the propriety of including them in an enquiry like the present one.

As was to be expected, the amount spent on rent by the two different sets of households varied considerably. Those industrial households which were renting their dwellings expended on the average 10s. 8d. per week, and these formed 80 per cent. of the total. About 18 per cent. were owning or buying their houses with an average weekly outlay of 12s. 9d. on purchase instalments, ground rent, rates, etc. About 2 per cent., chiefly miners' households, were provided with dwellings rent-free by their employers. The average distributed over all households was 10s. 10d. per week, or about one eighth of the total weekly expenditure. The average outlay on rent by agricultural households was 4s. 9d. per week, or less than half that of the industrial households, and only 8·2 per cent., or rather less than one twelfth, of their total expenditure. Over 95 per cent. of the agricultural households were rent-paying and 4½ per cent. were buying their houses. Of the 95 per cent., two-fifths were living in houses provided by their employers, and the average value at which these dwellings were reckoned as part payment of wages was 3s. 11d. per week. Those buying their houses paid on the average 4s. 8d. per week in instalments, rates and ground rent, etc.

The expenditure on clothing (9s. 4d. and 5s. 10d., respectively) appeared to the Ministry to be likely to be in error on the high side, owing to the wide variations in expenditure at different periods of the year, and, in consequence, particulars of the outlay week by week throughout the year were obtained from 2,100 industrial and nearly 400 agricultural households. The records from these showed some appreciable reduction in the average expenditure—namely, 8s. 2d. and 5s. 3d. per week respectively, and the Ministry are of opinion that these latter figures are a more correct indication of the cost of clothing.

As regards fuel and light, there was very little difference between the two classes in the outlay on coal, but it is not clear why coke was not reckoned with coal instead of with candles, firewood and matches. For agricultural households the expenditure on oil is naturally considerable, but its use by town households is not great, and with the spread of electricity supply to rural areas even there it is declining appreciably.

But by far the largest amounts expended, and the largest pro-

portionate expenditure also, as shown in both sets of budgets, were
on food and on what is called " Other Items." The industrial
budgets record an expenditure of 34s. 1d. on food and 25s. 7d. on
" Other Items," being 39·5 per cent. and 29·7 per cent., respectively,
of the total expenditure. In the present index-number food is
given a weight of 60 per cent. and other items 4 per cent. It is
doubtful, however, whether many of the 49 different classes of food
in the present budgets found their way into the earlier returns, and
the index-number has confined its recording of price fluctuations to
15 of the principal articles which apparently covered 75 per cent.
of food expenditure. The proportion in the present budgets appear
to be at least 70 per cent., so there is very little alteration, and it
is doubtful whether the inclusion of the remaining articles would
show any difference in the general price fluctuations so far as food
is concerned.

Tables are given showing the amounts consumed of certain of
the foods, but it is not easy to gather much information as to pre-
vailing prices by comparing the money expenditure. Meat of all
kinds, including mince, seems to average at least 1s. a lb., a
price which appears somewhat high, and makes one wonder how
butchers manage to dispose of all their thin flank, shin of beef and
scrag of mutton. The wide fluctuation in the prices of eggs is
borne out by the marked variation in the numbers consumed and
the almost constant expenditure thereon. There has been lately
some question of reserving the limited quantity of cheese available
in order to supply certain occupations with a food which they are
in the habit of consuming to a greater extent than is general. Such
a consumption does not appear in the figures, which only show a
consumption of seven-tenths of a pound per week per industrial
family of 4, although the agricultural budget consumes nine-tenths
of a pound. More milk and eggs are bought by industrial than by
agricultural families, but this may be due to the latter obtaining
milk free from employers and to their being in a better position for
enabling them to keep fowls. The number of eggs produced at
home by agricultural households averaged 3 per week over the
total number of households, and this brings their consumption of
eggs up to the level of the industrial families.

It is, however, when we come to what are classified as " Other
Items " that we are impressed with the considerable, and indeed
large, expenditure on articles and services which do not ordinarily
come to the mind when we are thinking of the cost of living. Rent,
food, clothes, fuel and light occur at once to us, but all the hundred
and one little necessaries and comforts for carrying on and main-
taining the home are not realized to anything like the extent they

should be. Yet 30 per cent. of an industrial household expenditure goes in payment for these items, and over 25 per cent. of that of an agricultural household, and it is doubtful whether their cost is even now fully covered. In the case of drink and holidays, clearly it is not. It is very doubtful, however, whether, for the purpose of a monthly index-number, the majority of these items should be taken into account statistically and quite a good proportion of them are in the nature of standing charges which vary little (*e.g.*, travelling, social insurance payments, other insurances, trade union and friendly society payments). It is well, nevertheless, to have a definite record from so large a sample of what the " other " expenses of an ordinary household are, and to know that the " cost of living " is not by any means only food, clothing, fuel, and shelter.

It remains only to refer in terms of the highest appreciation to the work of the Ministry of Labour in producing such an elaborate and extensive report on a subject which has for some years been urgently calling for enquiry. Of the innumerable points which must have arisen for decision, many must have been open only to a choice of two evils, and we can feel confident that the best possible method of presentation of the results of the enquiry has been chosen by the Ministry.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

CONTENTS

1.—*Theory of Probability*. By Harold Jeffreys. Oxford: Clarendon Press. 1939. $9\frac{3}{4}'' \times 6\frac{3}{4}''$. vi + 380 pp. 21*s*.

When a mathematician of the distinction of Dr. Harold Jeffreys writes a book on probability it is advisable for all those who have any interest in the subject to pay careful attention to what he says. Dr. Jeffreys, as is well known, defines probability as a degree of rational belief and lays down a set of axioms in virtue of which probability so defined becomes measurable. He then uses the theory of inverse probability throughout. It is fair to say that many statisticians, perhaps most, would not accept Jeffreys' theory, but it is doubtful how far they are conscious of the dilemma which led Jeffreys to propound it. Without some such subjective definition one cannot put into numerical terms one's degree of confidence that some law of nature or observed sequence of events will continue to hold good in the future. We cannot by deductive logic alone show that sun will rise to-morrow (because it has always done so in the past) or that Halley's comet will return. But it may be said these are predictions from scientific laws and have always been verified in the past. This, however, simply pushes the difficulty one step farther back. Is the fact that scientific laws have been verified in the past any proof that they will continue to be verified in the future? It is not, nevertheless, we all believe that this is true. All our daily habits and plans for the future are based on similar assumptions.

Most statisticians use the frequency notion of probability in practice, whether or not they regard it as fundamental. Let us for the moment consider the case of an agricultural experiment in which we have two samples of the same crop grown under otherwise uniform conditions but one treated with fertilizer A and another with fertilizer B. Suppose we find B does better than A, and that it is very improbable that the experiment could be a sample from a hypothetical infinite population of experiments in which the average yields of B and A were the same. We are certainly justified

in concluding that B has done better than A; and we could state the odds against this being a chance occurrence if the fertilizers are equally efficacious. But can we state in numerical terms our degree of confidence that if the experiment is repeated again in the future, B will again prove better than A. Without a numerical theory of subjective probability we certainly cannot. The reviewer is inclined to think that we cannot put such beliefs into numerical terms at all.

If, however, one is to reject a carefully constructed self-consistent theory, one must reject its axioms. Jeffreys' first axiom is " *Given p, q is either more or less probable than r, or both are equally probable; and no two of these alternatives are true.* Now, if probability is a degree of rational belief, this axiom might legitimately be rejected. Its acceptance is a matter of opinion. It by no means follows that degrees of rational belief can be ordered in a linear series. They may not form a unidimensional set. *q* might be more probable than *r* in some ways and less in others. If we ask in this sense, given the present state of the world, whether it is more probable that Japan or China will ultimately be victorious, the answer might fluctuate according as one were a Chinese or a Japanese, or according as one considered social, religious or military factors, and there would be no obvious way of combining these different factors to produce a universally valid judgment.

Nevertheless Dr. Jeffreys is justified in asking, " If you reject the definition of probability as a degree of rational belief or, while accepting it, refuse to admit that probabilities so defined are linearly orderable what are you going to put in its place." There are two alternatives. We might use the frequency definition or some modification of the classical definition, leaving out the phrase " equally likely," which seems to beg the question. Now, in our opinion the frequency notion of probability is by far the easiest to use in statistics, but cannot be regarded as fundamental. It must be asked in what sense we regard the relative frequency as tending to a limit when the number of trials is increased. Certainly not in the ordinary mathematical sense, for the penny *might* turn up heads every time. We can only define the limit, for a conceptual system which will be of use in practice, in terms of the notion of probability itself. If we already know what we mean by probability, the uniform law of large numbers provides a way of doing this. Hence if we reject Jeffreys' view we require some form of the classical definition.

We ourselves would accept the treatment given by M. S. Bartlett in his recent paper in this *Journal* on " The Present Position of Mathematical Statistics," or the definition given by A. C. Aitken in his *Statistical Mathematics* with the omission of the words " *all equally likely a priori* " which Aitken himself admits are not necessary in an *abstract formulation*. The definition would then read as follows : " If an event *E* can result from the phases of a system *S*, there being *n* different phases and no more; and if *m* of these phases entail the occurrence of *E* (so that *n — m* do not) then *m/n* is the probability *p(E, S)* of *E* with respect to *S*."

If there are an infinite number of phases the definition has to be extended by the theory of measure. " If M is the measure of the whole aggregate S of possible phases and pM is the measure of the aggregate of E-phases contained in it, then p is the probability $p(E, S)$." On this view the *theory* of probability is the theory of combination of systems such as S and for pure theory no more is required. In proving the uniform law of large numbers, for example, the phases of the system S are the possible results of a series of sets of trials, each set consisting of an infinite number of trials. Each trial is, in the simplest case, itself a system with two phases. The law of large numbers proves that if E is the subset of S all of whose members possess the following property, then $p(E, S) \to 1$ as $n_1 \to \infty$. The property—we use Bartlett's formulation—is this. If, n being the number of trials and r the number of successes, r/n be plotted against n, the graph for $n > n_1$ is enclosed by a band, centre $\frac{1}{2}$, of width converging to 0 as n increases. All this is pure mathematics and provides a theory of frequency. When we come to application we naturally have to investigate whether observations behave consistently with our conceptual model. In the present example, for instance, we might find a value of n, for which $p(E, S)$ is greater than say 0·999 and make as many trials ($n > n_1$) as we had time and energy for. We could then see whether the resulting values of r/n were enclosed within the band. If they were, we could then say our observations were consistent with our theory. If they were not, we should doubt the theory. We should then try re-adjusting our postulated limit of $\frac{1}{2}$, and if we still failed to get results consistent with the theory, we might begin to suppose we had chosen the wrong phase system S. We are here in the same position as in all scientific investigations. We set up a theory, we work out its consequences and then examine whether the data are consistent with the consequences deduced.

The choice of the right phase system S is of the utmost importance in applications. If we choose the wrong one we shall arrive at conclusions inconsistent with the data and waste our time. But we are not obliged to analyse the reasons for our choice. Every scientific theory must start from certain postulates or axioms which are taken for granted. But here we must be honest with ourselves. If we are asked, " Why have you chosen this particular phase system ? " we should be obliged to reply, " Because we think that the phases *are* equally likely," or in equivalent terms. And if pressed for a definition of what we mean by equally likely, we might reply, " We think that in the observational system to which our conceptual model was intended to apply, all the phases would occur equally often in the long run." But this comes very near to being an argument in a circle—Dr. Jeffreys would say that it is— because the notion of a phase system was designed to avoid the difficulties associated with the notion of the limit of a frequency, and if each depends on the other we are no further. It is not, however, quite an argument in a circle. We might put up this defence for it. We started from certain observed phenomena of statistical regularity; when pennies are thrown, the proportion of

heads does seem to settle down to about $\frac{1}{2}$ with increasing number of throws, and many statistical ratios appear to be similarly stable. On further examination, however, we found difficulty in putting our naïve notion of statistical regularity into rigorous and at the same time useful form. We found it could be done in terms of a mathematically specified phase system, and so we decided to adopt the latter, and as long as our theory does not lead to contradictions we shall continue to use it.

If this line of argument is found unsatisfactory, we could only say, " Well, we think the phases are equally likely," and leave it at that. But then we are getting very close to Jeffreys' position, because we are admitting that we can make a judgment of equal likeliness independent of frequency. This is nearly the same as saying that our degrees of rational belief in the different phases are equal. If we admitted this, we should have to accept Jeffreys' Axiom I, and the obstacles to accepting the rest of his theory would no longer be nearly so great.

We would sum up, therefore, by saying that it is impossible to be dogmatic about the precise logical basis chosen for the theory of probability. It is at present, and in our judgment is likely to remain, a matter of opinion. Whether the frequency theory itself, the modified classical theory or Jeffreys' subjective theory be adopted, the conclusions drawn in any practical case would seldom differ very much—certainly not in large sample problems.

Most statisticians of to-day have been brought up on and have got used to direct probability methods, and to them a theory based on inverse probability throughout comes with a certain air of strangeness and requires a little practice to follow. There are certain less fundamental difficulties than those already dealt with, connected with methods of assessing prior probabilities. In the author's own words, " The prior probabilities needed to express initial ignorance of the value of a quantity to be estimated when there is nothing to call special attention to a particular value are (1) uniform distribution for an unrestricted quantity or one restricted to lie within given finite limits, (2) logarithmic distribution for one restricted to lie between 0 and ∞. When a question of significance arises, that is, where previous considerations call attention to some particular value, half the prior probability is concentrated at that value. This is the simplicity postulate. It needs some elaboration when several parameters arise for consideration separately." In spite of the ingenious justification of these rules that are given, there does seem a good deal of arbitrariness about them, and the reviewer would still find it somewhat difficult to accept them even after accepting Axiom I.

The book contains chapters on fundamental notions, direct probabilities, estimation problems, approximate methods and simplifications and significance tests. It then concludes with a discussion of frequency definitions and direct methods and some general scientific questions. It is well written, the mathematical technique, of course, leaves nothing to be desired, and the theory is applied to most of the main problems of statistics. Here the

statistical reader must get accustomed to most of the results with which he is familiar coming out a little differently owing to the use of the inverse method. It is interesting to note, however, that the forms of the " t " and " z " distributions are unchanged.

Most of the applications are physical. Some of the author's reflections are worth quoting. Of the law of gravitation he says, " In fact agreement with Newton's law was not given by the data used to establish it, because these data included the main inequalities of the moon; it was not given during his lifetime, because the data included the long inequality of Jupiter and Saturn; and when Einstein's modification was adopted the agreement of observation with Newton's law was 300 times as good as Newton ever knew. Even the latter appears at present as powerless as Newton's to explain the long empirical term in the moon's longitude and the secular motion of the node of Venus. *There has not been a single date in the history of the law of gravitation when a modern significance test would not have rejected all laws and left us with no law.* Nevertheless the law did lead to improvement for centuries and it was only when an alternative was sufficiently precisely stated to make verifiable predictions that Newton's law could be dropped—except of course in the cases where it is still a valid approximation to Einstein's, which happen to be most cases. The test required, in fact, is not whether the null hypothesis is altogether satisfactory, but whether any suggested alternative is likely to give an improvement in representing future data. If the null hypothesis is not altogether satisfactory we can still point to the apparent discrepancies as possibly needing future attention, and attention to their amount gives an indication of the general magnitude of the errors likely to arise if it is used; and that is the best we can do." Again, " There is no Newtonian explanation in sight for either the perihelion of Mercury; the node of Venus, or the eclipse displacement; whilst Einstein's law explains the first and third. The node of Venus is not evidence for Newton's law because this does not explain it either. This discrepancy is apparently significant, but what it signifies is not clear; it may represent some systematic error of observation or internal correlation of the errors; though these have not been adequately tested. What is clear, however, is that it is irrelevant to the decision between the laws of gravitation. So far as any law can be proved by observation (and no law can be proved any other way) Einstein's law is proved within the solar system." We thoroughly agree with the following passage : " There is no excuse whatever for omitting to give a properly determined standard error. It is a necessity in stating the accuracy of any interpretation of the data, if the law is right; if the law is wrong it is necessary to discover that it is wrong. All statisticians will agree with me here, but my applications are mostly in subjects where the need is still very inadequately appreciated. Again the best way of finding out whether a law is wrong is to apply it as far as possible beyond the original data, and the same applies to any suggested explanation. But if we have not a determination of the standard errors of the parameters in the law we have no way

of saying whether any discrepancy found is genuine or could be removed by a permissible readjustment of the parameters, with a corresponding improvement in their accuracy. The usual reason given for the omission is that there may be some other sources of error and that the statement of a standard error expresses a claim of an accuracy that future events may not justify. This rests on a complete failure to understand the nature of induction. It is essential to the possibility of induction that we shall be prepared for occasional wrong decisions; to require finality is to deny the possibility of scientific enquiry at all. The argument, however, does not prevent its users from asserting systematic differences when the estimates agree within the amounts indicated by the standard errors, supposing these genuine, or from denying them when they are flagrant."

Finally, since in the past there has been so much emphasis on the differences of opinion between statisticians, and the large amount which they all have in common has tended to be overlooked, it is pleasure to find that the author, though carefully pointing out where he differs from R. A. Fisher, says, "The general agreement between Professor R. A. Fisher and myself has been indicated in many places. The apparent differences have been much exaggerated owing to a rather unfortunate discussion some years ago, which was full of misunderstandings on both sides. Fisher thought that a prior probability based on ignorance was meant to be a statement of a known frequency, whereas it was meant merely to be a formal way of stating that ignorance, and I had been insisting for some years that no probability is simply a frequency. I thought that he was attacking the 'Student' rule, of which my result for the general least squares problem was an extension; at the time, to my regret, I had not read 'Student's' papers, and it was not till considerably later that I saw the intimate relation between his methods and mine. This discussion no longer, in my opinion, needs any attention." And again, "I have in fact been repeatedly struck in my own work, after being led on general principles to a solution of a problem, to find that Fisher had already grasped the essentials by some brilliant piece of common sense, and that his results would either be identical with mine or would differ only in cases where we should both be very doubtful. As a matter of fact I have applied my significance tests to numerous applications that have also been worked out by Fisher's and have not yet found a disagreement in the actual decisions reached."

To conclude, the reviewer would like to depart from precedent by expressing his regret at the delay in the appearance of this article. For this the disorientation and new tasks imposed by the war must be held responsible.   J. O. I.

2.—*Statistical Calculations for Beginners*. By E. G. Chambers. Cambridge University Press, 1940. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. viii + 110 pp. 7s. 6d. net.

As is indicated by its title, this book does not claim to be a treatise on the theory of statistics. Its purpose is to explain as

simply as possible how to perform the calculations involved in the commoner statistical methods. These, the author says rightly, are to the research worker what tools are to the carpenter, and the object of the book is to teach the experimenter how to use these tools without attempting to contribute to any of the experimental sciences to which statistical methods are applied.

This makes for simplicity. It is certainly simpler to teach the beginner how to calculate a mean, a standard deviation and a correlation-coefficient without having to deal with the more difficult question of why he should do so and what use he can make of them. Indeed, the student beginner often prefers to follow at first simple instructions and to learn how to handle the new tool, leaving the question of why and to what end a later study.

This thorough understanding of the psychology of the student-beginner is the main asset of this book. The first six chapters, in particular, are well written and should be easy reading for the beginner. They deal with averages, measures of dispersion, the normal distribution, significance of mean and of differences between means, and are well provided with exercises in the style of a text-book. As an only lack it may strike the reader that little use has been made of the instructive value of simple examples. Certain tabular and graphical aids are compiled in useful appendices, one of which gives a table of the generalized geometric mean

$$\sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{n_1 + n_2}} \text{ for } n_1, n_2 = 10(1)50$$

which facilitates the t-test for the difference between means.

With the second more advanced part of the book we begin to feel more of the disadvantages of divorcing method from the subject matter to which it is applied. To understand the χ^2 test it is simpler to commence with the problem of the experimenter and to introduce χ^2 as its natural solution.

The scope of the book is confined to a limited number of statistics and the author had to make a selection. His choice is, naturally, biassed in favour of those useful to his own researches, *i.e.* in favour of statistics used in experimental psychology.

The book should be of great help to the beginner.   H. O. H.

3.—*Statistical Methods for Medical and Biological Students.* By Gunnar Dahlberg. London : Allen and Unwin. 1940. 8½″ × 5½″. 232 pp.   10s. 6d. net.

This publication is another attempt to teach the elements of statistics to students with " a limited knowledge of mathematics." The book is intended for " medical students in particular."

It is a pity that the author has attempted to compromise between the " demands of the mathematical statistician " and the " mathematical limitations of the medical and biological student." He has tried to " explain the (theoretical) reasoning in words." We should have rather liked to have the author's expert view on the *applications* of statistical methods to the medical sciences.

Conventional lines of books on theoretical statistics are followed.

The theory of probability and of permutations and combinations is given first, and is followed by an outline of the binomial theorem and the normal curve. The experimenter who wants to learn why and how mathematical conceptions enter into his sphere will find but little satisfaction. However, in Chapter IV an instructive example is given. Human growth is considered as being conditioned by five factors, each of which is a simple alternative, such as " good nutrition " or " bad nutrition." It is shown by simple logic that with independent factors a binomial distribution of human heights will result from the simple theory.

Treatment of averages and measures of variation also follows conventional lines, but much of the subject-matter given is out of date. Moreover simplicity is sometimes achieved at the expense of accuracy. On p. 94 the formula for the standard deviation of a product is obviously not valid for factors with zero mean, and such essential limitations should be mentioned. The discussion of Sheppard's correction ignores the conditions under which it is valid, although group intervals of the order of the standard deviation are considered.

Elementary cases of an analysis of variance are given in terms of problems in medical research, and the comparative importance of individual variation, inter-individual variation, environmental and hereditary factors is discussed. There is, however, a conspicuous lack of modern methods. An interesting source of variation enters through the uncertainty of a single diagnosis or determination of an experimental quantity. Repetition of the determination with variation in technique are therefore necessary. The resulting discrepancies are comparable to the sampling error in field experimentation.

The book will be of interest to professional statisticians and give them an idea of the difficulties encountered in medical research; it will also he of some help to the medical student.   H. O. H.

4.—*A Detailed Proof of the Chi-Square Test of Goodness of Fit.* By E. Russell Greenhood, jr. Cambridge, Mass. : Harvard University Press; London : H. Milford. 1940. $6\frac{3}{4}'' \times 4\frac{1}{2}''$. xiii + 61 pp. 8s. net.

This book is the prize essay published by the Harvard Chapter of the Phi Beta Kappa Society, and chosen from among the best honours theses of Harvard College. The choice is made " for excellence in scholarship, originality of treatment, and general interest." Apparently this essay has been chosen for its originality in treatment, or rather style. " To avoid making this paper a typical hundred per cent cut-and-dried mathematical dissertation," says the author in his introduction, " I have presented in the next section the story of how I happen to be writing on the chi-square curve. . . ."

Mathematically speaking, there is no original contribution in this thesis. It is an assembly of known arguments from scattered references. But the author deals in detail with just those difficulties which the beginner encounters in learning about the test. A real simplification is introduced when for the integration in hyperspace

the constant factor is neglected and the term $(\chi^2)^{\frac{1}{2}n-1}$ derived by simply considering the *dimension* of the space. The random sample is allowed to " roam " about in hyperspace, obeying certain (linear) restrictions, but otherwise making full use of its " degrees of freedom." No advanced formula for the surface of a hypersphere is therefore required.

In the last chapter, where the conditions of the validity of the Chi-square test are discussed, the author tells us in a heartening American college jargon when and where " the Chi-curve has gone haywire," and he finishes up his " fireworks display " with " two terrific high-powered articles " (one of them being W. F. Sheppard's fundamental paper) which are " all over his head." The author believes that nothing new is said in these articles, because " when he reads S. S. Wilks, who seems to be pretty well up on such matters," he finds his ideas confirmed.

All those who have difficulties in understanding the Chi square test are advised to read this instructive as well as amusing thesis, and all those who teach the subject will certainly be interested in the difficulties their students encounter.   H. O. H.

5.—*Education and the Birth Rate.*   By Grace G. Leybourne and Kenneth White.   London : Jonathan Cape.   1940.   vii + 375 pp. 10s. 6d.

In a society in which the specialist has an ever more important part to play, the mechanism of training and education will be of great importance in the life of the population as a whole, and will also influence general social behaviour.   Dr. Leybourne and Mr. White have attempted to trace the connection between the educational system in this country and the birth rate; and they have succeeded in marshalling and putting together a large number of important and hitherto unco-ordinated facts.

The connection between the educational system and the birth rate may be twofold.   In the first place, the high cost of education and the value that society places on high educational attainments may combine in bringing about a limitation of families.   Secondly, the prospective decline in births will itself have important repercussions on the structure of our educational system.   The present work is concerned mainly with the first question, though in the last chapter the authors touch upon the second.   Their main problem, however, is by its very nature difficult to examine.   The relation between cost of education, income and family size is a complicated one, and little statistical evidence bearing on it exists. A study of this relation must therefore proceed in an indirect way, and for this reason the authors have collected a large amount of material dealing with differences in the cost of education.   They then argue as follows : In present-day society education is valued, and the longer it lasts, the higher is its value.   At the same time a long education is very much more costly, and there are also qualitative differences between the various kinds of education.   Hence parents anxious to assure a good social standing for their children will limit their families so as to be able to provide the coveted

high-class education. This applies not only to the middle class who would like to send their children to a " public " school, for many working-class parents desire a secondary education for their children in order to assure them of a white collar job. The cost of a secondary education would include the renunciation of the wages the worker's child would ordinarily have earned, and may be as heavy in proportion to income as is the cost of a " public " school education to a middle-class parent.

With this argument few people would disagree. But it is not a statistical argument, and it is, indeed, difficult to find statistics bearing upon it. The authors can only give figures showing the difference in the cost of education. And it is here that the main value of the book lies. Differentials in educational costs have been known to exist for a long time, but this is the first time that their magnitude has been measured. Information is given about the cost of State education, "independent" secondary education, university education, and education for the professions. There are also sections dealing with financial assistance given by the State and by private agencies. Discrepancies in cost are shown to be very large. A " moderate " secondary education for a boy would cost £37 a year, a " good " one £65, whilst for a " distinguished " education the parent would have to pay no less than £184 every year. It is clear that the number of people who can afford to give even a " good " secondary education to three or four children simultaneously must be small. But the extent to which this inability makes for conscious family limitation is a matter for conjecture.

It is the chief merit of this valuable book that it has brought together the facts about differences in educational costs—as far as the reviewer's knowledge goes—for the first time. This alone should assure it a place on the shelves of all those interested in general educational problems. A tribute is also due to the printers and publishers for the very attractive way in which the book has been produced.   E. G.

6.—*Capitalism the Creator.* By Carl Snyder. New York: The Macmillan Company. London: Macmillan. 1940. 473 pp. 16*s.*

This is a book about which it is possible to have no two opinions. Either one accepts implicitly and without question Mr. Snyder's philosophy, or one rejects it equally violently and wholeheartedly. For this is not only a general defence of capitalism as a way of economic life, but it is also a defence of the detailed working of nineteenth-century industrialism.

Mr. Snyder's thesis is a simple one. The capitalist system produced in the nineteenth and early twentieth centuries is probably the most spectacular advance in material welfare in the history of civilization. There were ups and downs, it is true, but these were due to the failure to understand the operation of the monetary mechanism and to curb speculative activity. This remarkable rate of progress came to an end only because of external interferences with the free working of the system—Governments began to attempt

a re-distribution of the national income by imposing heavy taxation and labour to demand social security, higher wages and collective bargaining. If we can get rid of these interferences with the freedom of action of the profit-seeking capitalist entrepreneur, if we can make Government and labour understand that progress depends on capital accumulation (which means unrestricted profit-making), then man's natural genius and inventiveness will ensure that we set out again on the upward path to prosperity.

Two distinct issues are raised by the author. The first consists of a strong attack upon all that is implicit in the New Deal philosophy of the Roosevelt Administration. The second is a plea for more quantitative analysis and less unsupported theoretical discussion in the economic sphere.

In the reviewer's opinion, it is not profitable to criticize in any detail the views put forward by Mr. Snyder in discussing the first of these issues. The following quotations are typical :—

> " We spend vastly more per capita on education than any other nation. With what different aim ? To establish a monstrous system of unconscious regimentation and uniformity." (Page 278.)
> ". . . unemployed insurance seems to encourage unemployment." (Page 316.)
> " It would seem, therefore, that the attempt to raise wages through action of labour unions, particularly when accompanied by strikes, can only work harm." (Page 177.)

The impersonal, indeed inhumanitarian manner in which the author approaches his subject is almost terrifying. On not one occasion does he mention that behind each step of material advance lie human endeavour and sacrifice. There is no recognition of the undeniable fact that the remarkable industrial gains of the nineteenth century were only won at the cost of untold human suffering—of small children working excessive hours in the appalling atmosphere of cotton-mills, and of women and girls doing the work of pit-ponies in unlit and ill-ventilated coal-mines. If the correction of such evils means a slackening in the rate of material progress, then the majority of people undoubtedly will prefer to postpone the millennium into the more distant future. After all, we in this country are learning by experience what the unfettered inventiveness of man in one sphere of activity can mean, and the lives we are living can hardly be called civilized or, indeed, progressive.

Two points of criticism may be raised against the *facts* presented by Mr. Snyder. First, there is evidence to show that the emergence of capitalism from its expansionist into, at best, its stationary phase was not due solely to external interferences with the free working of the system. Indeed, it was inevitable that as soon as capitalism passed from the phase of quantitative expansion (roughly the nineteenth century) into the phase of qualitative expansion (roughly the twentieth century), it should develop a larger measure of instability—an instability which was magnified by certain well-known rigidities in the system. The second point of criticism

concerns the author's over-simplified statement of the nature of the trade cycle. To Mr. Snyder, the trade cycle is an exclusively monetary phenomenon (all other explanations are, typically, "an accumulation of nonsense"). He sees the dominant cause of the boom and the slump in the growth and collapse of speculative activity engendered by an undue expansion and consequent contraction of the volume of bank credit. The remedy proposed is wise credit control through the mechanism of bank rate, and the author emphasizes the importance of not allowing the boom to develop speculative proportions. As far as it goes, Mr. Snyder's explanation of the trade cycle will command general acceptance. Unfortunately, it does not go far enough. The researches of recent years into the causes of the trade cycle have shown conclusively that monetary influences are only a partial and possibly not even a primary cause of these disturbances to the steady flow of economic activity.

With the second main issue underlying the argument of the book —namely, the plea for more quantitative analysis in economics—it is possible to feel more sympathy. As the author shows by several pungent examples, there are considerable economic phenomena which are susceptible to analysis by the methods of measurement and correlation. In the United States, in particular, important efforts are being made to organize the multitude of individual measurements into measurements of those broad magnitudes which play such an important role in current monetary and trade-cycle theory. At the same time, the need for a greater emphasis upon quantitative analysis does not mean that we should abandon qualitative analysis, as Mr. Snyder would have us believe. The economic system is sufficiently complex and our measurements sufficiently inaccurate to render the causation process a matter for speculation, and this is only one instance of the necessity for well-considered qualitative judgment. In fact, the author affords an awful example of the results of relying exclusively on quantitative analysis, since the close correlation which his charts show between the general price level and the quantity of money leads him to the conclusion that the former is determined solely by changes in the latter.

<div align="right">J. E. W.</div>

7.—*Unemployment and the Unemployed.* By H. W. Singer. London: P. S. King. 1940. 8½″ × 5½″. x + 152 pp. 8s. 6d. net.

Dr. Singer is an expert on unemployment and the unemployed. It is therefore very gratifying that he has produced this small book devoted to these basic economic and social questions. To appreciate the book it must be remembered that Dr. Singer writes for the " average student of social affairs," and he has valiantly attempted to explain his problems in a brief and simple manner for everyday people. Space is the greatest of the author's limiting factors; he is obliged to compress into a few pages his discussion of questions which in their complexity each call for a separate volume if they are to receive adequate treatment. Nevertheless Dr. Singer skilfully lays bare the essentials of each problem clearly and succinctly,

whilst maintaining a conversational tone which will hold the interest of the lay reader.

The book is divided into two parts. The first is devoted to an explanation of unemployment as an economic phenomenon. The second examines it in its social aspects, particularly with reference to the psychological problems of the unemployed individual. The first part is indeed a victim of the author's necessity to confine himself within this " scanty plot of ground." A typical example of the general brevity is to be found in the introductory section, where a discussion of the various economic theories of the causes and cures of unemployment is attempted without mention of either Mr. Keynes's theories or the classical theory of unemployment. The rest of Part I consists of an analysis of the various factors which make it difficult for the unemployed person to find a job. There are five characteristics of an unemployed person : sex, age, previous industrial history, family responsibilities and location. There are also three aspects of any job which might be vacant : its location, its technical nature and the wage offered. Dr. Singer shows how each one of these factors, in the man himself and in the jobs that are offered, can and do lead to unemployment. In fact it appears from this analysis that anyone out of work is out of work solely because the jobs offered require qualities which the person does not possess and is unable or unwilling to obtain. Here again the treatment is brief, but Dr. Singer is to be congratulated on showing clearly how unemployment is produced, the effects of unemployment insurance regulations and poor relief, what steps have been taken to cure the various types of unemployment which occur, and why each one has failed or achieved only partial success. It is, however, a little unfortunate that the unemployed man should have obtained so much sympathy from Dr. Singer. Whilst no one will deny that unemployment is a great evil and that its victims deserve the utmost sympathy and consideration, there is a tendency, not only in this book but in wide circles, to accept the characteristics of the unemployed man as rigid unalterable qualities to which all other factors must be subjected. Thus training schemes, State-assisted migration of labour and other practical measures designed to adapt men to jobs are doomed almost before they begin, in the eyes of such social students. Yet ever since man began the struggle to feed, clothe, shelter and amuse himself he has had to adapt himself to the prevailing conditions; Robinson Crusoe would have been lost in the first week if he had refused to change his occupation. Although it is generally agreed that adaptation is not easy, this is no reason for the rejection of all schemes designed to facilitate it.

The second part of the book reveals a keen insight into the psychological problems of the unemployed man. The various types of man are considered in turn : the bitter young man who feels frustrated, the man who has resigned himself to a life " on the dole," the man who finds himself out of work at forty. The effects upon these men of the various government schemes are examined, and the vexed questions of the dole, the means test and the problem of compulsion are carefully investigated. Dr. Singer approaches

these problems with a fine human understanding, and once more reveals his overwhelming sympathy for the unemployed man. It is perhaps disappointing that he stops short in his analysis and does not indicate the measures that would obtain the greatest co-operation on the part of the unemployed in the task of adapting them to the changing scenes of the industrial play. This leaves the reader with the impression that the problems are insoluble and that it is impossible for the actors to find a happy ending to the tragedy.

The style of the book is refreshing and lucid, but to many it may prove irritating, since names and phrases such as "Herrings and Cream " and " The Cheshire Cat " are invented on every page for well-known problems; it is a little unfortunate that the student should be obliged to learn this new terminology for the purpose of reading one book from the vast selection upon this subject. On the other hand, many readers will be grateful for the lively sense of humour shown in these apt mnemonics, which may prove valuable signposts through the difficult problems of unemployment.

It is disappointing that, in dealing with a subject in which there are more official and unofficial statistics than in any other, Dr. Singer does not give figures to illustrate the nature and extent of the problems discussed. There is also little mention of the considerable research into unemployment which has been made in recent years. Sir William Beveridge, R. G. D. Allen and Brinley Thomas, among others, have explained quantitatively many of the problems Dr. Singer considers, and their results would doubtless have proved most instructive had they been utilized.

A final judgment must, however, consider the object of the book, namely, to introduce the lay reader to the problems of unemployment and the unemployed man, and in this respect there can be no doubt that Dr. Singer has produced a book which will long serve as an introductory volume to the problem of unemployment for all students of social affairs.   H. W. R.

8.—*Penal Reform in England :* Introductory Essays on some aspects of English Criminal Policy. English Studies in Criminal Science, Vol. I. Edited by L. Radzinowicz and J. W. Cecil Turner, with a preface by P. H. Winfield, Rouse Ball Professor of English Law, Cambridge. London: P. S. King, 1940. $8\frac{1}{2}'' \times 5\frac{1}{2}''$; 177 pp. 10*s*. 6*d*.

This small volume, the first of a series of English Studies in Criminal Science (published under the auspices of the Committee appointed by the Faculty Board of Law in the University of Cambridge to consider the promotion of Research and Teaching in Criminal Science), is a work of collaboration by several distinguished authors, whose essays discuss some aspects of English Criminal Policy.

In the first essay the official records of criminal statistics are examined for, lacking the knowledge made available by recorded facts, criminal policy and penal reforms cannot be shaped. The assembled data—maintained upon a more or less comparable basis since 1857—show that during the past three-quarters of a century

a notable decrease has occurred in the incidence of civil or non-indictable offences (with the exception of Highway Offences due to the advent of the motor car), with, on the other hand, a significant increase in the incidence of indictable offences, or crime proper. Of the latter offences 95 per cent. were due to crimes against property, *i.e.*, crimes of acquisitiveness, the large majority of which consist of larcenies, the remaining 5 per cent. comprising " crimes against the person," *i.e.*, crimes of violence, sexual crimes, etc.   The general reader will probably be shocked to find official statistics indicate that, by comparison with experience covering the period 1857–66, crimes against morals (rapes, indecent assaults, unnatural offences) have more than doubled in recent years, and that the increase is most noticeable in the case of unnatural offences, which have quadrupled in number since the beginning of the century.

Then follow chapters concerned with the great changes which have characterized the treatment of offenders by the legislature during the last half-century, the administration of penal legislative measures, the jurisdiction of juvenile courts, and the rational treatment of juvenile delinquents, while the final sections of the book discuss the chief aspects of treatment accorded offenders under various systems, *e.g.*, the *Borstal System*, which aims at the reclamation of young people who have made a false start in life; the *Prison System*, which enables the individual prisoner to earn certain privileges as a reward for industry and good behaviour, and by a system of training endeavours to transform the prisoner into a responsible citizen; and the *Probationer System*, which plans the reformation of the delinquent by some method which avoids deprivation of liberty.

Though the learned editors regret the impossibility of treating exhaustively in one small volume the topics selected for discussion, it is believed readers will be attracted by the success achieved by well-known students of penal systems in compressing within pleasantly readable compass without omitting anything essential, this series of essays, which constitute a most interesting approach to the study and understanding of some of the problems characterizing criminal science in England.   P. G. F.

STATISTICAL NOTES

(1) British Official Statistics

We give on page 76 a table summarizing the oversea trade of the United Kingdom for the years 1939 and 1940. The excess of imports over exports last year amounted to £661 million, which was £261 million more than in 1939 and £273 million more than in 1938. The rate at which the adverse balance accrued tended to decline during the year, the figures for the four quarters being, in million £, 179, 165, 162 and 155. The decline between the first and second quarters was due mainly to exports rising by £10 million; subsequently, following the restriction of the area with which trade was possible and the heavy attacks on our shipping and our ports, imports declined more rapidly in value than exports, though the proportionate fall for exports (especially re-exports) was much greater than for imports. The figures are given below, with corresponding figures for each month from July to December, during which period the effective trading area remained substantially unchanged.

Period			Imports	Exports	Re-exports	Excess of imports over exports
			£ mill.	£ mill.	£ mill.	£ mill.
1st Quarter	...	...	308·3	119·9	9·7	178·7
2nd ,,	...	...	304·2	129·8	9·7	164·7
3rd ,,	...	...	260·2	93·9	4·4	161·9
4th ,.	...	...	227·2	69·5	2·4	155 3
Year 1940	...	...	1,099·9	413·1	26·2	660·6
July ...	...	...	87·0	31·2	1·8	54·0
August ...	...	...	95·0	32·5	1·4	61 1
September	...	...	80·6	31·2	1·2	48·2
October ...	...	...	85·1	23·4	1·0	60·7
November...	...	...	72·9	21·7	0·7	50·5
December	...	...	73·6	24·4	0·7 .	48·5

Note.—Owing to corrections. the aggregates for the three months do not agree in all cases with the quarterly totals.

The excess of imports over exports in December was little in excess of the figure for September, the lowest of the year. The value of imports was higher in December than in November, while exports of United Kingdom goods exceeded those in both October and November, the value in the latter month being the lowest this century. Re-exports declined, however, from £723,000 to £653,000, the lowest figure on record.

In the last quarter of the year imports of food, drink and tobacco amounted to £83·6 million, the proportion of total imports, which was 45 per cent. in 1939 and 41 per cent. in the first quarter of 1940, falling to 37 per cent. Imports of raw materials also declined towards the end of the year, the proportion in the last quarter being only 26 per cent. of the total as against 32 per cent. in the first. Imports of manufactured goods varied but little in value from quarter to quarter, the proportion of the total rising from 26 to 36 per cent. There were, however, marked changes in the make-up of this total. All the heavy metal groups—iron and steel, non-ferrous metals, machinery and vehicles (including aircraft)— increased in importance during the year, and the figures show clearly the rising tide of ·imports connected directly with our war effort. The figures for iron and steel and for vehicles are, perhaps, worthy of record—quarter by quarter they are, in million £ :—iron and steel, 5·9, 6·7, 13·6 and 19·2, the figures for November and December alone exceeding the largest year's import in the last war; vehicles, 1·1, 5·8, 13·1 and 12·8—the value of aircraft included in the figures after the first quarter must have been considerable. Most other descriptions of imported manufactures were lower in value in the last than in the first quarter of the year. Imports of foodstuffs were affected greatly by the enemy occupation of Denmark and the Netherlands, which caused, for example, a fall of one-half in the value of the dairy produce imported. Fresh fruit and vegetables was the other food group imports of which have fallen to a marked extent; while part of this was due to the deliberate restriction of imports which were not essential, part resulted from the enemy occupation of the Channel Islands. Grain and flour showed the greatest rise in value (£38·4 million) of any group in relation to the year 1939, though iron and steel was the largest in relation to 1938. Other large increases were recorded for wool (£26·7 million), cotton (£15·8 million), rubber (£14·3 million) and both the unmanufactured and the manufactured oils group (£13·8 million and £27·2 million) in addition to the metal groups above mentioned.

The recovery of £2·7 million in exports of United Kingdom goods in December was mainly in respect of manufactured articles. The rise in these was very general, but much the largest increases were recorded for cotton goods—exports of which had been extremely low in October and November—and for vehicles (including loco-motives, ships and aircraft). The value in the latter group was the highest since April, and this is almost the only group of manu-factures exports of which in December exceeded those in September; the reason for this exception from the general fall in exports during

the last quarter of the year is presumably that exports of aircraft for our allies are included in this group. Comparing the figures for December with those for July, the first month when the trading area was approximately the same as at present, the textile groups, including apparel, fell from £8·8 million to £6·6 million or by 25 per cent. while the metal groups, excluding vehicles, fell from £7·5 million to £5·9 million or by 21 per cent., the overall decline for manufactures being 19 per cent. Exports of food, drink and tobacco fell by about 40 per cent. between September and November and recovered in December to about 25 per cent. below the September or July level, the fall and rise being largely due to the movement in the beverages group, which comprises mainly spirits. Exports of raw materials in December were under half those in July, exports of coal having fallen from £1,753,000 to £679,000.

Movements and Classes	Twelve Months ended December 1939	Twelve Months ended December 1940	Increase (+) or Decrease (−)
Imports, c.i.f.—	£'000	£'000	£'000
Food, drink and tobacco	398,367	421,004	(+) 22,637
Raw materials and articles mainly un-manufactured	240,664	336,495	(+) 95,831
Articles wholly or mainly manufactured	239,377	336,209	(+) 96,832
Other articles	7,105	6,161	(−) 944
Total Imports ...	885,513	1,099,869	(+) 214,356
Exports, f.o.b.—			
United Kingdom Produce and Manufactures—			
Food, drink and tobacco	35,721	33,352	(−) 2,369
Raw materials and articles mainly un-manufactured	54,392	36,292	(−) 18,100
Articles wholly or mainly manufac-tured	338,167	335,960	(−) 2,207
Other articles	11,256	7,479	(−) 3,777
Imported Merchandise—			
Food, drink and tobacco	10,855	7,914	(−) 2,941
Raw materials and articles mainly un-manufactured	24,554	12,449	(−) 12,105
Articles wholly or mainly manufac-tured	10,039	5,603	(−) 4,436
Other articles	585	224	(−) 361
Total Exports ...	485,569	439,273	(−) 46,296

Re-exports have fallen continuously from £4·4 million in April to £653,000 in December, partly because the bulk of our re-exports used to go to European countries and partly because of increased shipping difficulties. Raw materials, which used to comprise more than half of our re-exports, are now the smallest of the three classes. Food, drink and tobacco showed the least reduction (about one-quarter) compared with 1938, probably because we continue to supply such goods (notably tea) to Eire.

The general level of *wholesale prices* continued to rise during the whole of 1940, and the Board of Trade index-number (average of prices in 1930 = 100) which had reached 122·3 in December 1939 had risen to 148·6 in December 1940. In the three months before the war the index-number had remained at 98·1. The increase was thus 21·5 per cent. over the twelve months and 51·5 per cent. since the commencement of the war. As between the food groups and the groups of articles covering industrial materials and manufactures there was not a great difference in the rise of prices over the year 1940, being 22·4 and 21 per cent. respectively, but the increase in food prices since the war began was 60 per cent. compared with an increase of 47·2 per cent. in materials and manufactures. This may be partly due to government control over a number of important materials, especially metals. Non-ferrous metals, for example, show very little variation in price during 1940, although there was an increase of about 13 per cent. during the first four months of the war. The prices of all these metals are controlled, except that of tin which rose slightly during 1940.

The greatest proportionate rise (33·6 per cent.) in any group in 1940 was in that termed " Other food and tobacco," where prices had advanced very steeply in a number of cases. Those for fruits and vegetables were stated to have risen from 70 to 300 per cent. Some of these articles (*e.g.*, onions, oranges, bananas) had by the end of the year practically vanished from the markets and their prices had become subject to control at various dates. Other articles in the group also advanced considerably and, as compared with December 1939, prices in December 1940 had advanced from 40 to 50 per cent. in the cases of milk, potatoes, tobacco, eggs, coffee and poultry. Prices of wet fish advanced nearly 100 per cent. The advance in tobacco prices was, of course, due to the largely increased taxation. Of the other groups wool showed an advance during the year of 27·3 per cent., iron and steel 26·4 per cent., coal 19·5 per cent. In the miscellaneous group of materials the advance was 28·4 per cent. chiefly due to the increased prices of paper-making materials,

wood pulp and timber. The prices in other groups which had shown large advances during the first four months of the war did not show advances on such a considerable scale in 1940. Cereals rose 13·9 per cent. as compared with 54 per cent. in the period September to December 1939, cotton 4·7 per cent. compared with 50·4 per cent., and other textiles 7·9 per cent. compared with 37·9 per cent. Of course the control by the Government of many industrial materials and articles of food and their subsidization in some cases tend to render many market-price quotations somewhat artificial, but except in those cases where there are scarce or short supplies the index-numbers are a fair indication of the course of prices.

The Board of Trade index-numbers of wholesale prices for the last five months of 1940 are given below, together with the increases in December 1940 over December 1939 and over August 1939.

Date	Total Food	Total not Food	All Articles	Basic Materials	Inter-mediate Products	Manu-factured Articles	Building Materials
October 1940 ...	143·1	142·3	142·7	146·0	155·8	136·4	128·4
November ,, ...	143·2	148·6	146·9	152·7	159·7	143·6	131·4
December ,, ...	144·5	150·4	148·6	158·2	160·7	144·3	132·8
December . 1939 ...	*118·1*	*124·3*	*122·3*	*135·0*	*125·0*	*122·0*	*110·3*
August ,, ...	*90·4*	*102·2*	*98·1*	*94·5*	*104·0*	*108·7*	*104·1*
Percentage increase of December, 1940, over:	%	%	%	%	%	%	%
December 1939 ...	22·4	21·0	21·5	17·0	28 6	18·3	20·4
August ,, ...	59·6	47·2	51·4	67·4	54·5	32·8	27·6

The figures for certain other British index-numbers of wholesale prices and the index-number of wholesale prices prepared by the United States Bureau of Labour are given below.

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866-77 = 100)	*The Times* (1913 = 100)	United States (Bureau of Labour) (1926 = 100)
October 1940 ...	142·7	98·9	131·8	159·4	78·2
November ,, ...	146·9	99·8	132·7	163·0	79·0
December ,, ...	148·6	100·9	134·5	165·2	79·8
December 1939 ...	*122·3*	*91·7*	*120·1*	*142·5*	*79·0*
August ,, ...	*98·1*	*70·3*	*90·4*	*114·5*	*74·8*

During the last three months of 1940 general retail prices continued to advance, and by January 1st, 1941, showed an increase of

about 3·7 per cent. above those prevailing at October 1st. 1940. According to the Ministry of Labour's index-number of the cost of living among working-class families the increase was greatest in clothing (10 per cent.), most of which was probably due to the sales tax. There was also an increase of 1·8 per cent. in the cost of food, 4·2 per cent. in that of fuel and light and 1·4 per cent. in the cost of miscellaneous articles of consumption. The increased food prices were chiefly those of milk, eggs and potatoes. Prices of sugar were reduced 1d. per lb. There has been some considerable scarcity in the case of certain unrationed foods.

Compared with September 1st, 1939, the general index-number of the cost of living has advanced rather more than 26 per cent. Food prices have advanced 25 per cent., clothing 59 per cent., fuel and light 23 per cent., and miscellaneous items of expenditure 24 per cent. There has been but a very slight increase in working-class rents.

The index-numbers for the period October 1st, 1940, to January 1st, 1941, are given below.

(Average prices for 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
Oct. 1st, 1940 ...	169	164	300	214	219	189
Nov. 1st, ,, ...	172	164	305–310	215	220	192
Nov. 30th, ,, ...	173	164	320	219	221	195
Jan. 1st, 1941 ...	172	164	330	223	222	196
Jan. 1st, 1940 ...	*157*	*162*	*250*	*200*	*190*	*174*
Sept. 1st, 1939 ...	*138*	*162*	*205–210*	*180–185*	*180*	*155*

There was no very marked reduction in unemployment during the period October 14th, 1940, and January 13th, 1941, the numbers remaining on the registers of the Ministry of Labour's Employment Offices in Great Britian declining from 834,851 to 695,606 between the two dates, a reduction of 139,245, or about 16·7 per cent. It should be noted, however, that almost invariably there is a large increase in the number of the registered unemployed at the count in January; in one year (1935) the number increased by 291,000. In January 1941, on the other hand, the number actually fell, although the fall was a small one (9,673). No doubt the large number still on the registers is to some extent deceptive. It is probable that the adult male register still contains many that are on the verge of unemployability, either on account of advanced age or through long unemployment. Moreover, the unusually high proportion of

women on the registers points to the large increase in the search for work of women not normally available for employment. At the same time, owing to the steady absorption of younger men into the armed forces and the extreme scarcity of workers for many branches of industry, it might have been expected that the reductions in the ranks of unemployed workers would have been more rapid. Nevertheless with the increased control continually being exercised by the Minister of Labour over various classes of workers and the increased demands for labour in all kinds of " war work," the scarcity of really suitable labour is likely to become acute within the next few months. Compared with January 1940 there was a reduction in the numbers registered of over 823,000, 690,000 of whom were males over 18.

The following table shows the number of workpeople (insured and uninsured) on the registers of the Employment Offices of the Ministry of Labour and National Service in Great Britain.

Date	Wholly Unemployed	Temporarily stopped	Persons normally in Casual Employment	Total
Oct. 14th, 1940	635.431	171.082	28,338	834.851
Nov. 11th, ,, ...	603.241	163,364	24,575	791,180
Dec. 9th, ,.	541.900	141,848	21,531	705,279
Jan. 13th, 1941	521.388	152,381	21,837	695,606
Jan. 15th, 1940	*1,219,503*	*249,723*	*49,670*	*1,518,896*
Aug. 14th, 1939	*968,108*	*211,978*	*51,606*	*1,231,692*

Both rates of wages and earnings increased considerably during 1940, and the net effect of all the *changes in rates of wages* reported to the Ministry of Labour during the year amounted to a weekly increase of £2,148,000 to about 7,902,000 workpeople.* This increase is greater than in any recorded year with the exception of the period 1917–20. The above figures do not take into account the increased earnings resulting from fuller employment or much increased overtime. As regards agricultural labourers a national minimum wage of 48s. per week for ordinary male labourers was fixed by the Agricultural Wages Board for England and Wales and this took effect from June 30th, 1940. A similar minimum wage has also been established in Scotland by the District Committees. The fixing of this rate has resulted in an increase in wages in the various areas of Great Britain of from 9s. to 17s. per week. Government industrial workers in H.M. Dockyards have received an advance of 5s. per week, and adult non-industrial Government

* Excluding changes in the wages of agricultural labourers, domestic servants, Government employees, shop assistants and clerks.

employees on the lower scales of salaries have received advances generally of the same amount.

There was during the year a reduction in the weekly *hours of labour* to about 144,400 workpeople, and an increase in hours to 1200. Those principally affected were juveniles under 16 years of age, whose weekly hours were reduced to a maximum of 44 at the beginning of the year. The classes chiefly affected were van-boys, messengers, etc., theatre and cinema attendants, lift-boys, and boys and girls in the distributive trades. This reduction was under the provisions of the Young Persons (Employment) Act of 1938 and followed on a similar reduction in most manufacturing industries in July 1939 under a provision of the Factories Act of 1937. The reduction in hours averaged about 4¼ per week, and the increase about half an hour.

The net number of workpeople directly involved in *trade disputes* in 1940 was 300,500. Most of these disputes involved individual establishments only, and the majority were of very short duration. The total number of working days lost during the year was 941,000, a number lower than in any year of the century. More than three-fifths of the workpeople involved were in the coal-mining industry, and the disputes therein accounted for nearly 54 per cent. of the working days lost. The two disputes causing greatest loss of time were one in the coal-mining industry of Yorkshire and one in the linen trade at Belfast, these caused the loss of 130,000 and 57,000 working days, respectively. The dispute in the linen trade, which involved one firm only, lasted about six weeks.

·The value of wholesale trading in Textiles showed a considerable fall during the last three months of 1940 compared with the corresponding months of 1939. The decline was common to both the home and export sales. According to the index-number of sales prepared by the Bank of England and the Textile Association, there was a decline in each of the three months. The home-trade index-numbers were 157, 81 and 76 for October, November and December 1940, compared with 170, 137 and 105 for the corresponding months of 1939. The export numbers were 73, 88 and 71, compared with 88, 103 and 96 in 1939. The combined numbers were 152, 81 and 76 for the last three months of 1940, and those for 1939 were 166, 135 and 104 respectively. Owing to increased prices the fall in the volume of trade must have been even more considerable.

Statistics of *retail sales* prepared by the Bank of England in conjunction with retail distributors' Associations show that over the 12 months February 1940 to January 1941 there was an increase of 3·3 per cent. in the amount of sales compared with the previous 12 months. Sales of food increased 2·7 per cent. and of articles other than food 4·2 per cent. Bearing in mind the considerable increase in food prices, and also in other articles of consumption, especially since the imposition of the purchase tax, the volume of business represented by the value of the sales has declined very appreciably. During December 1940 and January 1941 even the value of the sales has declined over the same months of the previous sales-year.

CURRENT NOTES

In consequence of the lamented death of the President, Mr. Henry W. Macrosty, the Council held an extraordinary meeting on February 6th, and, under Bye-law No. 15, appointed Mr. Hector Leak as President of the Society, to hold office until the next Annual General Meeting.

Two letters from Sir Alfred Flux, addressed to the late President, his old friend and colleague, arrived after the publication of the last issue of the *Journal*, and are printed below. The first, dated November 25th, came through Messrs. Cook's agency and was received on February 28th; the second, transmitted by the Red Cross and dated January 11th, came late in March.

> *Kongevej* 18
> *Fredensborg,*
> *Denmark.*
> 25*th November*, 1940.

MY DEAR MACROSTY,

Your tidings of old friends and of how matters are going in your own family circle are always welcome, and we are grateful for them. You know that the transit is not speedy, and I hope that my Red Cross message that announced the safe arrival of your letter of August 4th has reached, or will reach you. Perhaps, too, my message of condolence at the loss of his wife may have reached Verdier.

We are spending the winter in less urban surroundings than last year. You may, perhaps, recall as familiar the name of a town where we spent some shorter periods years ago. We are both enjoying good health, and do not hanker after the excitements of the metropolis! I wish I could do something useful, but find a spell of mental inactivity not altogether unpleasant. It is possible that some good may come out of it in the long run.

I hardly expect that your usual occupation—since retirement—will not be repeating itself also this year. Changes that might be made at normal times are less likely in times like the present.

Many thanks for thinking of us in connexion with your orchard produce. So far we have not done badly in that respect.

I am glad to learn of the prospect of a good year of work under your Presidency at the Society, and shall think about you

often, you may be sure. What a time we shall have when we meet again—in going over your memories ! Please convey my very warm greetings to old—and less old—colleagues from whom I am now separated, more particularly to those most closely associated in our work of years ago. It comes almost as a shock to think of your grandchildren as grown-ups—but that is, of course, quite in the order of things.

This will hardly, perhaps, reach you in time to overtake the greeting despatched when your latest messages arrived, but it brings to you and your wife and family our warmest greetings and best wishes for the coming year—also to mutual intimate friends.

<div align="right">Yours sincerely,
(signed)   A. W. FLUX.</div>

P.S.   Possibly my greeting may be timely as a 75th * birthday greeting. Best wishes for that day.

<div align="right">*Engtofte*
Fredensborg,
Denmark.</div>

MY DEAR MACROSTY,

Best new year and birthday greetings from us both. We are going strong and hope the same for you all. Thanks for enquiries.

<div align="right">FLUX.</div>

11,1,41.

The President and Council offer their congratulations to the following Fellows whose names appeared in the New Year's Honours list :—

> Sir Richard Hopkins, as G.C.B.
> R. G. Hawtrey, as C.B.
> C. T. Houghton, as C.B.E.

The Seventh Sectional Index to the *Journal*, covering Volumes LXXXVIII to CII (1925–1939), is now ready. An Index to the Supplement, Volumes I to VI (1934–1939), is appended. The issue is on sale to the public and to *Journal* subscribers at 2*s*. 6*d*. Fellows may have copies at one shilling, post free, on application.

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* This should have been 76th.—(Ed.)

OBITUARY

H. W. M.

READERS of the President's Inaugural Address already know that the brave spirit which inspired it can hearten and encourage us no more. Most of them will feel that the modest but vivid passages of autobiography hardly need a mere chronological supplement. But our President was a Victorian in the best sense of the adjective, and in Victorian days a biographer did not disdain to record statistical facts, so this tribute of his colleagues may begin with a short summary.

Henry William Macrosty was born in the Isle of Arran, on January 14th, 1865. He was the son of Henry Macrosty and Mary Calderwood and the eldest of eight sons and daughters. He was educated at Kirkcolm and privately in Edinburgh. In 1884 he received a permanent appointment in the Civil Service, in which he had already been employed for some years. Meanwhile in 1881 he had graduated B.A. in the University of London. It was the self-preparation for that degree which gave him that reading knowledge of the ancient languages which was to be a source of happiness in later life. He told me once that the long evenings of the winter 1915–16, after the death of his only son (killed in action December 19th, 1915), brought him back to Greek literature. He printed for private circulation a touching memoir of his son, Greek in its restraint. Macrosty may not have been a first-rate classical scholar, but to him the glory that was Greece was an illumination. He read Aeschylus in the last months of his life, and I regretted that my own Greek was too vestigial for it to be possible for us to discuss the Greek poets with the mutual enthusiasm Virgil, Horace and Catullus excited.

Of Macrosty's official career Sir Percy Ashley writes :—

" Macrosty entered the Civil Service in October 1884, being then rather less than twenty years of age, as a ' Man Clerk of the Lower Division ' (now the Executive Class), and was appointed to the Exchequer and Audit Department; this compelled him to live in London. Writers and lecturers on the machinery of government have occupied much time and space in showing how the Exchequer and Audit Department exemplifies all the fundamental principles of the British Constitution and parliamentary government; its importance, however, is not incompatible with a dull routine of work, especially for the lower ranks, and was even less so in the 'eighties

and 'nineties, when the scope of State action was so very restricted in comparison with what it has become in this century. Moreover at that time the possibilities of promotion from one grade of the service and of transfer from one department to another, with improving prospects, were much more limited than in recent years. Macrosty's work there, capably and conscientiously done, was a means of livelihood, but no more : in his posthumous inaugural address to the Society he has written of his ' detestation alike for the title and the job ' and his ' frantic and, for many years, futile efforts to escape from the prison-house.' His active mind turned to other interests—a degree of the University of London, membership of the Fabian Society, the study of the organization of industry. This last resulted in the publication of *The Trust Movement in British Industry,* a pioneer piece of detailed investigation of industrial combination and now a classic in the literature of that subject. It had all the characteristics of Macrosty's later work—the careful accumulation and marshalling of facts, impartial judgment and lucid exposition. It appeared at a fortunate time for Macrosty. The controversy aroused by Joseph Chamberlain's tariff proposals—a controversy in which Macrosty took an active though necessarily anonymous part on the free-trade side—did make clear to most of the disputants the need for fuller and more authoritative information about the movement of British industry, and one of the earliest acts of the Liberal Government of December 1905 was the passage of the Census of Production Act of 1906.

" The opening of the Census of Production Office of the Board of Trade in 1907 gave Macrosty his long-sought opportunity; the reputation won by his *Trust Movement* was the main cause of his transfer to the new office, and the illness and subsequent retirement of its first director, Mr. D. F. Schloss, threw on Macrosty most of the organization of the work, the consultations with industries and the preparation of schedules. I had met him several years earlier; I had joined the Board of Trade only a short time before his transfer, and I well remember the frankness of his delight at the new opportunities offered to him in a wholly congenial field. When in 1911 Mr. (now Sir) A. W. Flux came back from Canada to take up the post of Director of the Census of Production, Macrosty was appointed Assistant Director, and there began between them a close collaboration in official work which lasted for twenty years and in other fields of common interest endured to Macrosty's death.

" Progress on the second Census of Production was interrupted by the outbreak of war in August 1914; most of the staff of the office was dispersed among other departments, and the Director and Assistant Director went to the Board of Trade headquarters with

no very definite assignment of duties. The pressure of new and in some cases wholly unthought-of tasks upon the Board of Trade caused me to be charged with certain duties relating to the shipment of meat supplies from the Argentine to this country. I learned that Macrosty was not fully occupied; a happy inspiration led me to invoke his help; in a very short time, to my great relief, I found that the whole business could safely be left entirely to him, and it was. From that time to the end of the war Macrosty carried a great share of the responsibility for the supply of meat from overseas to the British and Allied forces. This involved very large and complicated problems of purchase, transport and distribution. There was a committee of representative shippers and shipowners; Macrosty was nominally its secretary, but he was in effect its chief executive officer (in association with Sir Thomas Robinson, the then Agent-General for Queensland), and the complete success of the work, carried out to the entire satisfaction of all interests concerned, was largely due to his organizing ability and untiring energy.

" At the end of the war there was a re-organization of the Board of Trade which brought the establishment of an independent Statistical Department with Flux as Assistant Secretary in charge and Macrosty as Senior Principal. From that time onward, despite periods of apparent stagnation and depression resulting from economy campaigns and apparent lack of sympathy in higher quarters the two men—so different in training, in type of mind and temperament—worked steadily together to create an organization equipped to meet the demands for fuller information as to trade and industry in the swiftly changing national and international conditions, and to win for the Statistical Department of the Board of Trade an increasing prestige. Their position at the head of that Department gave them authority among economic statisticians at home and abroad: and their diverse reputations reacted not less beneficially on the department. The official association came nominally to an end when Macrosty retired by force of the age-limit in 1930, but he was recalled to aid the department by carrying out a special piece of work which he completed in January 1931.

" To his colleagues, whether in the Board of Trade or in other Departments, Macrosty was always helpful and sympathetic; to his juniors, in rank or experience, he was always encouraging and stimulative. He showed unlimited patience with minds less familiar than his own with statistical problems and methods, or less rapid and supple, and took infinite pains to remove their difficulties. This, the virility of his talk and writing (manifesting itself even in the limitations of official style) and his wide interests won for him the enduring regard of all who worked with or under him,

and the farewell dinner given to him by past and present colleagues when he retired from the Service was a moving demonstration of real affection."

Macrosty was elected a Fellow of the Society in 1904. He served on the Council from 1917 to 1920 and again from 1925 to 1940, in June of which year he was elected President. From 1928 to 1940 he was a Joint Honorary Secretary, and after his retirement from the Board of Trade in 1930 devoted a great deal of his time and energy to the work of the Society, always careful to maintain its traditions while ready to develop and improve its practice. Although, as he told us, the bulk of his work was official and anonymous, his contributions to our *Journal* were important. He published the following papers, which were read and discussed at meetings :—

> Some Current Financial Problems. (1922.)
> Inflation and Deflation in the United States and the United Kingdom, 1919–23. (1927.)
> Statistics of British Shipping. (1926.)
> Trade and the Gold Standard. (1928.)
> The Overseas Trade of the United Kingdom, 1924–31. (1932.)
> The Overseas Trade of the United Kingdom, 1930–39. (1940.)

Other contributions to the *Journal* were :—

> Submerged Information—Banking (1927); The Third Census of Production of the United Kingdom (1924); The New Board of Trade Wholesale Prices Index Number (1935); beside many reviews of economic and financial books.

In 1927 he was awarded the Society's Guy Medal in silver. On the occasion of the Society's centenary, Macrosty compiled the *Annals of the Royal Statistical Society, 1834–1934*, and later supplemented it with some curious information, published in the *Journal*, concerning its " Early Years," which was discovered in ancient notebooks.

My acquaintance with Macrosty germinated and ripened into friendship within the Society. We had no official contacts and no social contacts other than those made in the Society. Indeed, our mutual affection culminated after we had almost ceased to meet at all, in the last year of his life. Like others of the inner circle of the Society, I had no difficulty in discovering his sterling qualities, his wisdom, enthusiasm and wide range of interests. But, although he was far indeed from being conceited or dictatorial, his enthusiastic

nature made him a little overwhelming *viva voce*. In our convivial moments, those pleasant evenings at the Dining Club the history of which he has recorded, his cheerful strident Doric was not always contributory to the catlike sense of peaceful well-being which it is the function of good wine to encourage. It was in the last year of his life, in his letters, that the essential man, the wise, kindly, scholarly gentleman beloved by his juniors, was revealed without disguise.

An only child not sent to boarding-school tends, I think (the subject might be worth statistical investigation), to make friendships with persons older than himself. Macrosty's fifteen years' seniority was no barrier between us. We were both in literary tastes and moral judgments—as we constantly reminded one the other—incorrigibly Victorian. Virgil and Horace, Catullus and Tacitus occur and recur in the thick bundle of letters 1939–40. I see I moved him to humorous and eloquent fury by the rather petulant remark that Horace was, after all, a cad and a snob. I acknowledged the force of his rejoinder, that while Horace had written caddish things, few men have never written something of which they were not ashamed and that no snob *could* have written of his father as Horace did.

A year ago when his little dog was killed he wrote :—

> " He was the most loving and joyous little chap, and I *loved* him. Now I feel a great loss in my life, which will never be made good. And I get afraid sometimes, for at times I want to rave against the senseless cruely of Fate which wiped out so happy a life, and at others I am terrified lest I fall into self-pity and the making of fine phrases."

The tenderness and stoicism are characteristic.

A letter of July 25th, 1940, was a reply to an outpouring of the despair which visits those who have no work of national importance and feel useless. I quote these sentences :—

> " . . . Therefore I am of importance and must get on with my job of work, whatever it is. It doesn't matter whether I think I am fit for better work or whether people do or do not recognize my ability. One of the few things I am proud of in my ' career ' as a Civil Servant is that I never asked for anything and never groused to anyone, despite many disappointments. I am a soldier, and ' there's no discharge in this war.' Consequently it is a weakening of the spirit to think that I am unneeded or to speculate as to the precise degree of uselessness to which I have attained. ' Courage, mon ami, le diable est mort,' said Denis, forgetting that the Enemy has to be slain

every day. Well, let us get to work again! That is my creed."

A fine creed and a delicate rebuke of a state of mind which depends as much on wounded self-esteem as anxious patriotism. The man whose spoken words often seemed, not harsh indeed but jangling, was exquisitely sensitive and a real physician for hurt minds.

The last letter of all was written on December 31st.

It begins :—

> " I've beaten my wife at bezique for the last time this year and I'm tired of trying to solve Patiences, so I'm going to sit down for a chat with you till it's time for the New Year to come in and for me to go out and then come in as the ' first foot ' of the year, as I've done for the past forty-six years. I said that this was a time for casting up accounts. Well, let's see what I've got."

Old-fashioned prejudices (I am a Victorian) do not allow me to print what a man says of those dear to him, but I may quote this :—

> " Thirdly, I retain all my interest in men and things and books, and still take pleasure in rediscovering something I once knew but had forgotten. Fourthly, I have full confidence in the justice of our cause and in our coming victory. And lastly, have I not achieved one ambition, to be President of the R.S.S. ? "

This is the conclusion :—

> " In a year's time may we be able to write to each other and say that it is well with us and with our folk. I want to go on as long as I can be of help to my people and can be intimate with my friends. I say to you, my beloved friend, be of good courage, as I shall try to be."

Dis aliter risum—as he would have said.

Macrosty's name may not be found in the indices of future text-books of statistics; nobody may be asked to write of him in a supplement to the *Dictionary of National Biography.* A century hence, if civilization and a list of our presidents survive so long, his name may be in the group of unknowns. But if civilization *does* survive to make that judgment possible, it will be because men like Macrosty had lived—joyous, kindly, wise men who cared for truth and loved their fellow-creatures, who did not affectedly despise the little pleasures and triumphs of daily life, but bore sorrow and disappointment like men.   M. G.

JAMES BONAR, M.A., LL.D.

By a peaceful death in sleep at his house at Hampstead a veteran scholar, in the fullest sense of the words, has passed away in the person of James Bonar.   Born in Perthshire so long ago as 1852, and educated at Glasgow Academy and University, and then at Balliol College, Oxford, where he obtained a First Class in Literae Humaniores, he added the rewarding experience of study at two German Universities.   His career in the public service of this country as Examiner in the Civil Service Commission lasted for over a quarter of a century, until he went in 1907 to Canada as Deputy Master of the Mint at Ottawa.   On returning to England in 1919 he was fortunate enough to get renewed possession of his former Hampstead home.   Here he lived in well-earned retirement for more than a score of years until his death.   But he was by no means idle; for it was not in Bonar's nature at any time to rest inactive.   In the congenial society of the healthiest and most pleasant hill-suburb of London he was henceforth a notable resident on whose rich stores of exact and comprehensive erudition in his favourite studies a large circle of appreciative friends with literary and other pursuits cognate to his own could draw as freely as he was ever ready to meet their calls.   High rank as an economist in particular, securely established by achieved performance, extended the range of friendly co-operation to fellow-workers in foreign countries; and an activity continued, with interest maintained in unabated vigour, to and beyond the normal span of human life won further meed of affectionate admiring honour for a venerable survivor and outstanding representative of the best traditions of a great bygone period of British economic reasoning and research.   Truly Bonar could be styled a " grand old man."

Both earlier and later he was an indefatigable student as well as an informed instructive teacher, and to his copious writing he added early lecturing in East London in 1877–1880 and subsequently in 1929 the Newmarch Lectureship at University College London. With the contents of the large library he formed he was in a remarkable degree intimately familiar, knowing the inside as well as the outside of his cherished books.   The Adam Smith Club was a pet life-long institution which he founded largely amongst working men, and he was also interested actively and practically in a venture of Industrial Co-operation.   A Vice-President of the Economic and of the Statistical Society, he took a lively part in their concerns, and his constant presence at the Council meetings of the latter will long be missed.   To Fellowship of the British Academy an Honorary Degree conferred by Cambridge for his work in connection

with Malthus at the commemoration of that economist was an ap t
complement.

When we turn to his published books we note that like Henry
Sidgwick he was both philosopher and economist. But, while in
1893, in his *Philosophy and Political Economy*, which was translated
into Japanese, he investigated with characteristically thorough care
the general relations between the two, and in his *Moral Sense* in
1930, fulfilling a promise of the original programme of the series of
which it formed a part of " forty years ago," he conducted a close
discriminating survey of a particular theory of moral philosophy, we
should distinguish between Sidgwick and him by urging that, while
the former might properly be held to have successfully entered
on a valuable excursion from philosophic speculation to economic
theorizing, Bonar was primarily, and more especially, an economist,
broadened, however, in his outlook by informed acquaintance with
philosophy. The theory of moral sense, it may be, interested him
not least on account of Adam Smith's connection with it, for he was
a whole-hearted worshipper of that economist, and to the last a firm
believer in the undiluted gospel of Free Trade. He was even, it
may be allowed, somewhat unduly intolerant of any possible doubt
about the abstract theory, and jibbed manifestly at awkward con-
tradiction in unwelcome, and, as he stoutly held, mistaken and
misleading practice. And, again, perhaps the most useful section of
the earlier book was that showing that the supposed blamed bond of
economic theory to the utilitarian creed was not fastened so tight as
to be incapable of disentanglement.

Bonar's work, indeed, in economics was considerable in quantity
and rare in quality, and his sense of the imperative needs of accurate
scholarship was as high and fine as his grip of logical reasoning was
firm and his knowledge of his material both large and minute. In
his smaller writings, such as the *Tables Turned* of 1926 with other
Dialogues of 1931, when he skilfully brought to life deceased famous
authorities, picturing them graphically as referring to problems of
later days as well as debating, by recurrence, those of their own times,
he exhibited the fullness and precision of his vivid realizing of the
persons introduced and his sure minute command of their most
intimate thought and its detailed expression. He was always
extremely, if not excessively, punctilious in reviews of books and
occasional articles in inserting multitudinous verified references.
His eminent service to economic theorizing was especially great in
his handling of the older writers, although a little Manual in 1903
was carefully designed and usefully accomplished, and he did much
to introduce the Austrian dialectic, of Bohm-Bawerk especially,
to English students. Of occasions of rendering that service the

editing of *Ricardo's Letters to Malthus* in 1887 (translated into
Magyar) was at once edifying and illuminating. It exemplified the
admirable manner in which real controversy could be conducted
between continuing friends, and it also threw fresh brilliant light,
hardly seen or recognized before, on the different standpoints of the
combatants. The avowed aim and acknowledged defects of Ricardo,
thus made palpable, explained much of the mischief wrought by
misunderstanding of his purpose, and the misjudged overstraining
of his unquestioned influence. These Letters were supplemented in
1899 by joint editorship with Professor Hollander of *Ricardo's
Letters to Trower*. The *Catalogue of Adam Smith's Library* in 1894
was similarly a noteworthy contribution to older British Biblio-
graphy as Bonar's handling of the Austrian furnished a pattern in
the critical expounding of more recent foreign theorizing. We
must, however, confess that his partnership with Mrs. Lucas in the
translation of Knapp's *Money* in 1924, was to our mind rather wasted
though assiduous labour, on what we ourselves have found, even in
an English dress, disappointingly hard to understand, and, in
consequence it may be, unconvincing beating of the air.

But by general admission Bonar's *chef d'œuvre* is his *Malthus and
his Work* of 1885, reproduced with some additional matter by the
process of photography in the second edition of 1924 and translated
into Japanese. Preceded by *Parson Malthus* in 1881 and supple-
mented by *Theories of Population from Raleigh to Arthur Young* in
1931, the monumental book has taken a permanent lofty place in the
classic literature of economic science. For this example of the
product of a scholarly pen Bonar will, we venture to pronounce, be
properly adjudged to be deservedly remembered to all time. The
book gave a sympathetic but just and accurate representation of the
man and his opinions. It placed him definitely on his merits among
the famed triad of the older British economists of immortal memory.
It dealt exhaustively with the population question, especially of
Malthus' age. With his own limitations Malthus also, with keen
insight and rare foresight, as Bonar pointed out, saw the failings of
Ricardo in general economic theory to which that economist's
disciples gave, unfortunately, subsequent exaggeration and the
" historical school " in still later controversy, not realizing that they
had thus been anticipated, directed damnatory reproach.

To this necessarily brief review of Bonar's work as an economist
a personal tribute remains to be appended, and it will doubtless be
received as not inappropriate or superfluous. It is certainly owing
from one who enjoyed the high privilege of a close dear friendship
lasting half a century. No friend, he feels, could be more kindly
more helpful or more staunch than the wise adviser and warm

sympathetic comrade who was to be found and loved in Jame·
Bonar.   L. L. P.

RAYMOND PEARL

Raymond Pearl, whose death from coronary thrombosis is an-
nounced, was born at Farmington, New Hampshire, in 1879.   He
took his first degree at Dartmouth College in 1899 and thereafter
worked in many universities; he was a pupil of Professor Karl
Pearson in the session 1905–6.   That was the session after that in
which I was a pupil of the great master, and I did not meet Pearl
until 1917–8, when he was on war service in England, but I remember
being told in 1905 by a friend at University College that Pearl carried
a full-sized Brunsviga calculating machine to and fro daily from his
rooms; he was a man of great and tireless energy, mental and
physical.   Those were the halcyon days of straight biometry.
Young biologists or naturalists who enjoyed counting and measuring
biological material had been taught a new method which had, or
seemed to them to have, the glory of mathematical science.   Few of
those whom Professor Hardy would call mathematicians were yet
interested; really hard mathematical statistics were still to come: '
sometimes we were daunted by a determinant, but school or easy\
college mathematics were the order of the day.

Pearl was an important contributor to the earlier volumes of
Biometrika.   His memoir on the weight of the human brain (re-
printed in *Studies in Human Biology*) is a first-class example of
straight biometry.   After his *Wanderjahre*, Pearl was appointed
biologist to the Maine Agricultural Experiment Station, and there
did some important work on poultry-breeding.   To this period
belongs his first book, *Modes of Research in Genetics*, published in
1915.   Reading this a quarter of a century later and comparing it
with his more recent books is interesting.   It has Pearl's admirable
clarity of style and sane critical outlook, combined with an enthusiasm
not yet touched by a tendency to over-emphasis.   He was still a keen
biometrician, but not bigoted.   Speaking of the then not quite extinct
controversy between biometricians and mendelians about heredity
he made this neat point: " It has repeatedly been the boast of the
biometric writers on this subject that their results were absolutely
free from any biological theories.   To this some of the more wicked
critics have retorted that their results were also quite free from any
biological significance.   Such a criticism is not true, but it has an
element of verity."   At his best, Pearl always had the knack of
hitting the right nail on the head.

After the last war, Pearl became the first professor of Biometry
and Vital Statistics in the School of Hygiene of Johns Hopkins

niversity— the elder sister of the School in Keppel Street, where he
is to be a frequent and welcome guest.   It was in his department
   Johns Hopkins that he carried out the experiments on the fruit-fly
rosophila melanogaster which, I think, constitute his highest claim
ɔ rank as a thoroughly original-minded investigator.   To study not
ndividuals but groups was not new, but to create experimental
populations under environments capable of precise modifications was
new.   Pearl, like Arthur Bacot the great entomologist, believed in
learning all he could about the likes and dislikes of the creatures he
intended to use before he began to experiment.   His technique was
masterly, and so his experiments were clean, and his grasp of bio-
metric methods enabled him to extract all the significance from his
data.   This research is described in *The Rate of Living* (the substance
of which was given in a course of lectures at University College
London in June 1927).   One has for the first time real life-tables for
an animal far distant from man, and a serious attempt to compare the
effect of age on mortality in different animals and under different
environmental conditions.   Pearl reduced life-tables to a common
measure by taking as unit percentiles of the life span, measured from
ɘ age at which q_x is a minimum to the age to which one in a thousand
vived—there are some technical objections to this, but I do not
  hk they are of a very serious kind.   Plotting $\log l_x$ against x and
ssuming that all the curves intersect the line joining l_o to l_w, where
w is the oldest age used, somewhere to the right of the origin, convex
curves will be above and concave below the " diagonal " from l_o—
which is the curve for mortality independent of age.   The line parallel
to the axis of x through l_o will be struldbrugian mortality or, if at w
the whole group perishes, that of the Wonderful One Hoss Shay.
Pearl showed that human mortality and that of the normal wild form
of Drosophila approximated most closely to the upper rectangular
type, while the short-lived vestigial form came nearer to the diagonal.
He studied the curve for different densities of population, found there
was an optimum density and that, when this was passed, the diagonal
of mortality was again approached.

   These are a few of the interesting points he made.   His general
discussion of them must be read in the original.   After the publication
of this book more work was done by Pearl and his pupils on age and
mortality in different animals, but his main interests passed to the
problems of human population-growth.   In a sense his other work
had been preparatory to this, he was passionately interested in the
biology of *man*, but, from the nature of the case, working on human
problems of population must mean using demographic data, and
demography is an old subject; Pearl had had many predecessors,
ome of whom had been as original-minded as he and anticipated his

novelties. Again, the world at large is more interested in man than in Drosophila; a fluent writer is tempted to write too much, and Pearl did not wholly resist the temptation. This is not to say that his later books were not valuable; they all contain much which is important and well said, especially his analyses of the factors of human fertility, but my feeling is that he was at his best when combining experimental work with biometry.

This has been an over-wordy summary of but a small part of Pearl's scientific activity, yet I have said nothing of what to an intimate friend of twenty-three years' standing was more important than Pearl's best paper, his personality. We met frequently; Pearl always spent a few days with me when he was in England, and in 1931 I enjoyed his wife's and his gracious hospitality in Baltimore.

We have spent pleasant nights in ancient English and German inns and sipped the port of the Statistical Dining Club together more than once. Our meetings were at long intervals, and so I have many letters. He was a correspondent whose letters were a joy to read. I have not much heart now to read old letters; these would tell the story of our little triumphs and disappointments, our friends and plans. They would also reveal the soul of a kindly gentleman who, while keen to do modern work and never one to bow the knee to the merely learned, had read and enjoyed the ancient writers whom, according to Oxford " greats " men, scientists in general and American scientists in particular ignore. More than this, they reveal a man who took infinite pains to help others, sometimes covering the kindness with a superficially cynical jest. It did not at all surprise me on my solitary visit to Baltimore to find that his staff adored him. Few of his enemies—he had bitter critics—would have remained enemies after a week in Pearl's company. It is not usually thought a compliment to say that a man of mature years is boyish. If the adjective connotes ignorance and crude egotism, it certainly has no application to Pearl. But if it connotes eagerness, intense pleasure in satisfying one's curiosity and a belief that others will be just as thrilled as oneself and not wast time in criticism, then I think Pearl *was* boyish. To him life was a great adventure, his life was happy, and he was a source of happiness to others. Were it not for the loss to others, I should call him happy in his death. For him there was no gradual deterioration; he has passed away swiftly without any cause to heed the sundial's warning—it is later than you think. At least two past presidents of the Society have lost a dear friend. M. G.

STATISTICAL AND ECONOMIC ARTICLES IN
RECENT PERIODICALS

UNITED KINGDOM—

Agricultural Economics Society, Journal of Proceedings of the,
November, 1940—Presidential Address : The Development of
Agricultural Statistics : *J. M. Ramsay.*

Annals of Eugenics, December, 1940—The recovery of inter-block
information in balanced incomplete block designs : *F. Yates.*
The analysis of a tsetse-fly population : *C. H. N. Jackson.*
A determination of the consanguinity rate in the general
hospital population of England and Wales : *J. Bell.* The
derivation of multivariate sampling formulae from univariate
formulae by symbolic operation: *M. G. Kendall.* The precision
of discriminant functions : *R. A. Fisher.*

The Banker—
  December, 1940—Dollar difficulties.
  January, 1941—The financial problem of 1941 : *J. Robinson.*
  The finance of the aircraft industry : *J. Mead.*
  February, 1941—Bank accounts for 1940. The problem of
  South America's commodity surpluses :   .

The Bankers' Magazine—
  December, 1940—Structure of the banking industry after
  the War : *Akanthos.*
  January, 1941—The War and its aftermath : *A. H. Gibson.*
  The Banking Year.
  February, 1941—Banking profits in 1940. Financing the War.

Economica, November, 1940—The terms of trade : *F. Benham.*
Capital value and income : *F. W. Paish.*

Economic Journal, December, 1940—The Jubilee of the Society :
The Editor. The propensity to save in Blackburn and Bristol :
Charles Madge. Hitler's New Economic Order for Europe :
C. W. Guillebaud. War finance and inflation : *Prof. A. C.*
Pigou. The tax curve : *A. Romney Green.* A fairer income
tax : *J. E. Allen.*

Eugenics Review, October 1940—The analysis of physique :
J. I. Cohen.

Geographical Journal, December, 1940—Fertility, productivity,
and classification of land in Britain : *L. Dudley Stamp.*

Royal Empire Society, Journal of the, December, 1940—An Indian
villager's budget : *H. J. Fells.*

Royal Meteorological Society, Quarterly Journal of the, January,
1941—Variations in annual, seasonal and monthly rainfall
over the British Isles, 1870–1939 : *J. Glasspoole.*

Public Administration, October, 1940—The Civil Service and the
War : *Sir Gwilym Gibbon.* The administration of food dis-
tribution in war-time : *R. Spann.*

INDIA—

> *Indian Journal of Economics, October,* 1940—Gandhi's economic ideal and creed: *Prof. Mohd Hassan.* The sociological elements in price economics: *R. Mukerjee.* The economics of soil erosion and its influence on national life: *B. Mukerjee.*
>
> *Sankhyā, Indian Journal of Statistics, September,* 1940—Rain storms and river floods in Orissa: *P. C. Mahalanobis.* On the problem of confounding in the general symmetrical factorial design: *R. C. Bose and K. Kishen.* Economic and business statistics in India: *H. Sinha.* Balanced confounded arrangements for the 5^n type of experiment: *K. R. Nair.* On a class of functional equations: *H. D. Bagchi.*

UNITED STATES—

> *Actuarial Society of America Transactions, No.* 104, *October,* 1940—Unemployment compensation in the United States: *R. A. Hohaus and F. S. Jahn.* Group life insurance—Recent mortality insurance of pensioners, and cost of conversions: *E. E. Cammack.* Errors and bias in the reporting of ages in census data: *R. J. Myers.*
>
> *American Economic Review, December,* 1940—Commercial policy, 1931 to 1939: *R. C. Snyder.* Incidence of taxation: *G. Holden.* Classical theory of inflation: *K. H. Niebyl.* Characteristics of savings deposits: *W. Welfing.* Wehrwirtschaft: Economics of military state: *H. W. Spiegel.*
>
> *American Statistical Association Journal, December,* 1940—Specific fertility rates for Detroit: *H. H. Pixley and C. H. Fischer.* On measuring the cost of life insurance: *T. S. Berry.* The sampling procedure of the 1940 population census: *F. F. Stephan, W. E. Deming and M. Hansen.* The trend of the birth rate by age of mother and order of birth: *A. J. Lotka and M. Spiegelman.* The calculation of correlation coefficients from ungrouped data with modern calculating machines: *P. S. Dwyer.* A graphic short cut to the moving average method of measuring seasonality: *W. A. Spurr.*
>
> *Annals of the American Academy of Political and Social Science, November,* 1940 (whole number)—Children in a depression decade (1930–1940).
>
> *Annals of Mathematical Statistics, December,* 1940—The distribution theory of runs: *A. M. Mood.* A generalization of the law of large numbers: *H. Geiringer.* Conditions of uniqueness in the problem of moments: *M. G. Kendall.* On samples from a normal bivariate population: *C. T. Hsu.* On a least squares adjustment of a sampled frequency table when the expected marginal totals are known: *W. E. Deming and F. F. Stephan.*
>
> *Harvard Business Review, Winter Number,* 1941—The paper industry in the emergency: *J. J. Hanks.* Food in a world at war: *J. S. Davis.*

UNITED STATES—*Contd.*

' *Journal of Political Economy, December,* 1940—John R. Commons concept of twentieth-century economics : *A. G. Gruchy.* The cost curve for steel production : *K. H. Wylie and M. Ezekiel.*

Millbank Memorial Fund Quarterly—

> *October,* 1940—Medical evaluation of nutritional status : *E. P. Hunt and C. E. Palmer.* Adapting programs of social welfare to a changing population : *P. Klein.* Population trends and problems of public health : *G. St. J. Perrott and Dorothy F. Holland.* The aging population and programs of security : *E. Clague.*
> *January,* 1941—Chronic disease among middle and old-age persons : *J. Downes.* Medical evaluation of nutritional status : *D. G. Wiehl.* Class birth rates in England and Wales 1921–1931 : *J. W. Innes.*

INTERNATIONAL—

International Labour Review—

> *October–November,* 1940—Relative wages in war-time : *E. J. Riches.* Economic organisation for total war : *E. F. Penrose.*
> *December,* 1940—The effect of war on the relative importance of producing centres with special reference to the textile industry : *E. Tilton Denhardt.*
> *January,* 1941—War-time organisation of the Canadian employment market : *E. H. Mayer.* Industrial home work in the United States : *F. S. Miller.*

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part IV, 1940, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom.

Dominions Office and Ministry of Health. Inter-Departmental Committee on the Reception of Children Overseas. Report. London : H.M.S.O., 1940. Cmd. 6213. 9¾″ × 6″. 8 pp. 2*d.*

Health, Ministry of. Report on conditions in reception areas, by a committee under the chairmanship of *Mr. Geoffrey Shakespeare, M.P.* London : H.M.S.O., 1941. 9¾″ × 6″. 18 pp. 3*d.*

Health, Ministry of, and Ministry of Home Security. Further recommendations of Lord Horder's Committee regarding the conditions in air raid shelters, with special reference to Health; and a brief statement of action taken by the Government thereon. London : H.M.S.O., 1940. Cmd. 6245. 9¼″ × 6″. 5 pp. 1*d.*

Home Office. Memorandum on the Workmen's Compensation Acts, 1925–1940. London : H.M.S.O., 1940. 9¼″ × 6″. 20 pp. 4*d.*

Labour and National Service, Ministry of. Weekly expenditure of working-class households in the United Kingdom in 1937–38. London : H.M.S.O., 1941. 13″ × 8¼″. 5 pp. 3*d.*

Select Committee on National Expenditure. Session 1940–41, 1st report. 7 pp. 2*d.* 2nd report. 6 pp. 1*d.* London : H.M.S.O., 1941. 9¾″ × 6″.

Trade, Board of. Statistical abstract for the United Kingdom . . . 1924–1938. 83rd number. London : H.M.S.O., 1940. Cmd. 6232. 9¾″ × 6″. xvii + 450 pp. 7*s.* 6*d.*

Treasury. Determination of Needs Bill : memorandum by the Assistance Board. London : H.M.S.O., 1941. Cmd. 6247. 9¼″ × 6″. 6 pp. 1*d.*

(b) British Empire.

Canada—

Dominion Bureau of Statistics. Census of industry. Food products, beverages, rubber, tobacco and miscellaneous manufactures based on vegetable products, 1934–1938. Ottawa : 1941. 9¾″ × 6¼″. 155 pp. 50*c.*

Eire—

Department of Industry and Commerce. Census of population. 1936. Vol. VII. Industries. Dublin : Stationery Office. 1940. 10″ × 6¼″. vii + 103 pp. 2*s.* 6*d.*

India—

Statistical Research Branch. Review of the trade of India in 1939–40 (66th issue). Delhi : Manager of Publications, 1940. 9½″ × 6¼″. ix + 314 pp. 5*s.*

Palestine—

Office of Statistics. Statistics of imports, exports and shipping for the year ending 31st December 1939 . . . Jerusalem : 1940. 9½″ × 6¾″. 294 pp. 5*s.*

Southern Rhodesia—

Department of Statistics. First report on the census of industrial production 1938 and 1939. Salisbury : 1940. 13″ × 8″. 24 pp. (typewritten).

<div align="center">(c) Foreign Countries.</div>

Argentina—

Direccion General de Estadistica. Estadistica industrial de la Republica
Argentina correspondiente al año 1938 . . . (Informe No. 76). Buenos
Aires : 1940. 10½″ ⋏ 7½″. 90 pp.

Buenos Aires. Municipalidad de la Ciudad de. Cuarto censo general 1936.
Poblacion 22–x–1936. Tomo IV, Fecundidad familias. Buenos Aires :
1940. 12″ ⨯ 9″. xxxvii + 393 pp.

Portugal—

Instituto Nacional de Estadistica. Elementos estatisticos relativos á liqui-
dação e cobrança das contribuições industrial e predial de 1 de julho de
1934 a 31 de dezembro de 1935. Pôrto : 1940. 10½″ ⨯ 7½″. 107 pp
Estatistica comparativa das receitas e despesas públicas nos anos econó-
micos de 1930–1931 a 1938. Pôrto : 1940. 10½″ 7½″. 93 pp.

Sweden—

K. Socialstyrelsen. Inresta utlanningar åren 1938 och 1939. Stockholm :
1940. 9½″ ⨯ 6½″. 48 pp.

United States of America—

Department of Labor, Children's Bureau. Publication No. 263. Methods of
assessing the physical fitness of children : a study of certain methods
based on anthropometric, clinical and socioeconomic observations made
of 713 7 year old white boys and girls in New Haven, Conn., over a
period of 19 or 20 months during 1934–36, by *R. M. Jenss and S. P.
Souther.* Washington : Govt. Printing Office, 1940. 9″ × 6″. vi +
121 pp. 15c.

<div align="center">(d) International.</div>

International Labour Office—

Studies and reports. Series B. No. 33. Studies in war economics. Mon-
treal : 1941 (London : P. S. King). 9¼″ × 6″. 199 pp. 4s.
——— Series B. No. 34. The labour situation in Great Britain : a
survey : May–October 1940. Montreal : 1941 (London : P. S. King).
9¼″ × 6″. 56 pp. 1s.

League of Nations—

Economic Intelligence Service. Statistical year-book of the League of
Nations. 1939–40. Geneva : 1940. (London : Allen & Unwin.
9¾″ × 7¼″. 285 pp. 10s.

<div align="center">II.—AUTHORS AND MISCELLANEOUS.</div>

Bagot (J. H.). Juvenile delinquency : a comparative study of the position
in Liverpool and England and Wales. London : J. Cape, 1941. (School
of Social Sciences and Administration, University of Liverpool). 8½″ × 5½″.
93 pp. 5s.

Bell (E. T.). The development of mathematics. New York & London :
McGraw-Hill, 1940. 9″ × 6″. xiii + 583 pp. 31s. 6d.

Bowen (Howard R.). English grants-in-aid : a study in the finance of local
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REVENUE OF THE UNITED KINGDOM

Net Produce in Quarters of **1940**, *and in Financial Years ended* *March* 31, **1939–40, 1938–39, 1937–38, 1936–37**

(000's omitted.)

QUARTERS, ended	March 31, 1940	June 30, 1940	Sept. 30, 1940	Dec. 31, 1940	Total for calendar year 1940
	£	£	£	£	£
Customs	64,091	70,637	74,231	81,652	290,611
Excise	36,750	36,400	18,700	57,886	179,736
Stamps and Estate etc. Duties ..	24,990	26,520	21,848	20,110	93,468
Other Inland Revenue Duties ...	760	90	130	128	1,108
Post Office	24,007	23,100	24,350	25,500	96,957
National Defence Contribution ...	7,530	4,310	6,620	5,305	23,765
Excess Profits Tax	40	6,660	19,722	17,401	43,823
	158,168	167,717	195,601	207,982	729,468
Income Tax and Surtax	336,967	29,819	76,952	103,546	547,314
	195,135	197,536		311,528	1,276,782
Motor Vehicle Duties ...	24,265	5,538		3,635	37,413
Crown Lands	280	280	270	290	1,120
Interest on Sundry Loans	658	123	223	325	1,629
Miscellaneous Receipts ...	6,484	4,642	7,918	9,352	28,396
				325,150	1,345,340

YEARS, ended March 31,	1939–40	1938–39	1939–40 (compared with 1938–39)		Corresponding years	
			Increase	Decrease	1937–38	1936–37
	£	£	£	£	£	£
Customs	262,136	226,326	35,810	—	221,561	211,282
Excise	137,900	114,200	23,700	—	113,700	109,500
Stamps and Estate etc. Duties	94,790	98,410	—	3,620	113,150	177,130
Land Tax and Mineral Rights Duty	—	—	—	250	—	730
Other Inland Revenues ...	1,300	1,550	—	250	1,730	
Post Office	88,657	89,850	—	1,193	87,375	82,950
National Defence Contribution	26,940	21,890	5,050	—	1,420	—
Excess Profits Tax	40	—	40	—	—	1,000
	611,763	552,226	64,600	5,063	538,936	582,592
Income Tax and Super Tax ...	459,863	398,431	61,432	—	355,016	310,777
	1,071,626	950,657	126,032	5,063	893,982	833,369
Motor Vehicle Duties	34,086	35,608	—	1,522	34,605	32,727
Crown Lands	1,250	1,330	—	80	1,330	1,350
Interest on Sundry Loans ...	4,916	5,699	—	783	5,230	4,550
Miscellaneous Receipts ...	20,364	12,941	7,423	—	13,509	24,600
Total	1,132,242	1,006,235	133,455	7,418	918,659	896,596
			NET INCR. 126,007			

TRADE OF THE UNITED KINGDOM
for the years 1938–39–40
(From the Monthly Trade Returns, December, 1940)

Values (c.i.f.) of Imports*

	Year ended December 31,			Increase or Decrease, 1940—1939	Increase or Decrease, 1940—1938
	1938	1939	1940		
	£	£	£	£	£
I FOOD, DRINK AND TOBACCO—					
A. Grain and flour	74,118,338	55,146,208	93,859,241	+ 38,413,033	+ 19,410,903
B. Feeding-stuffs for animals	11,419,250	8,935,947	8,374,166	− 561,781	− 3,045,084
C. Animals, living, for food	9,220,418	10,992,660	10,892,737	− 99,923	+ 1,672,319
D. Meat	90,679,859	93,297,467	97,074,247	+ 3,776,780	+ 6,394,388
E. Dairy produce	80,013,976	75,847,711	62,628,680	− 13,219,031	− 17,385,296
F. Fresh fruit and vegetables	37,657,557	34,992,123	27,304,012	− 7,688,111	− 10,353,545
G. Beverages and cocoa preparations	46,512,572	40,541,079	45,870,647	+ 5,329,568	− 641,925
H. Other food	56,910,094	64,716,378	66,167,123	+ 1,450,745	+ 9,257,029
I. Tobacco	23,284,633	13,597,922	8,832,900	− 4,765,022	− 14,451,733
Total, Class I	430,116,697	398,307,495	421,003,753	+ 22,696,258	− 9,112,944
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	14,739	18,451	34,468	+ 16,014	− 19,729
B. Other non-metalliferous mining and quarry products and the like	4,711,225	5,091,988	7,357,643	+ 2,265,655	− 2,646,418
C. Iron ore and scrap	11,152,127	9,699,807	16,555,718	+ 6,855,911	+ 5,403,591
D. Non-ferrous metalliferous ore and scrap	16,335,920	17,850,114	24,613,153	+ 6,763,039	− 8,277,233
E. Wood and timber	42,852,348	37,128,694	37,008,681	− 80,013	− 5,753,667
F. Raw cotton and cotton waste	29,579,628	34,190,457	49,952,619	+ 15,772,162	− 20,372,991
G. Wool, raw and waste, and woollen rags	42,618,055	40,426,722	67,096,592	+ 26,669,870	− 24,478,537
H. Silk, raw, knubs and noils	2,062,164	2,524,716	4,432,626	+ 1,907,910	− 2,370,462
I. Other textile materials	11,775,441	12,766,885	19,855,326	+ 7,088,441	− 8,079,885
J. Seeds and nuts for oil, oils, fats, resins and gums	30,595,876	30,908,725	44,721,449	+ 13,812,724	− 14,125,573
K. Hides and skins, undressed	18,233,113	15,465,036	15,653,251	+ 188,215	− 2,579,862
L. Paper-making materials	16,042,767	15,668,076	13,133,829	− 2,534,247	− 2,908,938
M. Rubber	11,503,292	9,463,717	23,735,185	+ 14,271,468	+ 12,231,893
N. Miscellaneous raw materials and articles mainly unmanufactured	10,416,972	9,470,109	12,254,663	+ 2,784,554	− 1,807,691
Total, Class II	217,923,667	240,663,500	336,495,203	+ 95,831,703	− 88,571,536
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel	8,298	6,055	2,932	− 3,123	+ 5,366
B. Pottery, glass, abrasives, &c.	7,341,104	5,191,705	1,659,746	− 3,534,959	− 5,681,358
C. Iron and steel and manufactures thereof	14,501,669	17,620,853	45,350,989	+ 27,730,134	+ 30,849,320
D. Non-ferrous metals and manufactures thereof	40,616,966	38,695,897	57,427,803	+ 18,731,906	− 16,610,837
E. Cutlery, hardware, implements and instruments	7,032,969	5,706,036	3,824,228	− 1,882,408	− 3,228,741
F. Electrical goods and apparatus	3,104,940	2,802,036	3,102,161	+ 300,125	− 2,779
G. Machinery	21,836,980	24,539,001	34,932,972	+ 10,393,971	+ 13,095,992
H. Manufactures of wool and timber	6,286,453	5,010,916	3,866,942	− 1,143,974	− 2,419,541
I. Cotton yarns and manufactures	3,135,264	2,269,400	2,728,988	+ 459,588	− 406,276
J. Woollen and worsted yarns and manufactures	3,838,109	3,435,577	1,913,443	− 1,492,134	− 1,894,666
K. Silk yarns and manufactures	4,916,149	3,604,990	927,544	− 2,677,446	− 4,018,605
L. Manufactures of other textile materials	4,695,997	7,097,830	15,406,924	+ 8,309,094	− 10,800,927
M. Apparel	8,027,854	5,655,066	1,188,839	− 4,466,227	− 6,839,015
N. Footwear	2,794,347	2,735,807	1,497,893	− 1,237,914	− 1,296,454
O. Chemicals, drugs, dyes and colours	13,268,241	15,920,189	17,069,227	+ 1,149,038	+ 3,800,986

* The value of the Imports represents the cost, insurance and freight; or, when goods are consigned for sale, the latest sale value of such goods.

Values (c.i.f.) of **Imports**—*Contd.*

	Year ended December 31,			Increase or Decrease, 1940—1939	Increase or Decrease, 1940—1938
	1938	1939	1940		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—*Contd.*	£	£	£	£	£
P. Oils, fats and resins, manufactured	44,070,485	45,702,348	72,890,697	− 27,188,349	− 28,820,212
Q. Leather and manufactures thereof	6,440,292	7,731,629	8,720,566	− 988,937	− 2,280,274
R. Paper, cardboard, &c.	14,841,996	15,666,149	16,285,552	− 619,403	+ 1,443,556
S. Vehicles (including locomotives, ships and aircraft)	4,532,639	7,948,735	32,775,201	− 24,826,466	− 28,242,562
T. Rubber manufactures	783,231	1,145,864	1,085,066	− 60,798	− 301,855
U. Miscellaneous articles wholly or mainly manufactured	21,576,719	20,867,137	13,521,020	− 7,346,117	− 8,055,699
Total, Class III	233,810,732	239,376,822	336,208,733	− 96,831,911	−102,398,001
IV. ANIMALS, NOT FOR FOOD	3,318,458	3,101,466	2,366,353	− 735,113	− 952,105
V. PARCEL POST	4,339,379	4,003,219	3,794,835	− 208,384	− 544,544
Total	919,508,933	885,512,502	1,099,865,877	−214,356,375	−180,359,944

Values (f.o.b.*) of **Exports of Produce and Manufactures**

	Year ended December 31,			Increase or Decrease, 1940—1939	Increase or Decrease, 1940—1938
	1938	1939	1940		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	1,670,308	1,202,618	606,231	− 596,417	− 1,064,077
B. Feeding-stuffs for animals	698,333	606,410	175,988	− 430,422	− 522,545
C. Animals, living, for food	8,555	29,463	26,264	− 3,199	+ 17,729
D. Meat	1,233,898	1,190,547	737,908	− 452,639	− 495,990
E. Dairy produce	1,112,231	1,117,218	927,477	− 189,741	− 184,654
F. Fresh fruit and vegetables	394,031	329,522	203,615	− 125,907	− 190,416
G. Beverages and cocoa preparations	13,824,631	15,945,471	19,612,019	+ 3,666,548	+ 5,787,388
H. Other food	12,036,852	10,286,906	6,276,119	− 4,010,787	− 5,760,733
I. Tobacco	4,914,904	5,012,699	4,786,844	− 225,855	− 128,060
Total, Class I	35,894,023	35,720,884	33,352,165	− 2,368,419	− 2,541,558
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	37,406,306	38,258,793	25,323,426	− 12,935,367	− 12,082,880
B. Other non-metalliferous mining and quarry products and the like	1,057,636	1,227,072	832,768	− 394,304	− 224,868
C. Iron ore and scrap	594,891	314,371	24,228	− 290,143	− 570,663
D. Non-ferrous metalliferous ores and scrap	2,298,115	1,570,111	243,668	− 1,326,443	− 2,054,447
E. Wood and timber	71,266	59,282	79,016	− 19,734	+ 7,750
F. Raw cotton and cotton waste	458,879	440,499	263,345	− 177,154	− 195,534
G. Wool, raw and waste, and woollen rags	6,262,842	4,707,347	3,274,443	− 1,432,904	− 2,988,399
H. Silk, raw, knubs and noils	661,414	1,357,348	639,026	− 718,322	− 22,388
I. Other textile materials	268,835	152,368	84,005	− 68,363	− 184,830
J. Seeds and nuts for oil, oils, fats, resins and gums	2,893,839	1,966,548	1,976,460	+ 9,912	− 917,379
K. Hides and skins, undressed	1,108,125	990,834	1,212,320	+ 221,486	+ 104,195
L. Paper-making materials	1,177,652	940,246	339,976	− 600,270	− 837,676
M. Rubber	227,256	218,994	185,524	− 33,470	− 41,732
N. Miscellaneous raw materials and articles mainly unmanufactured	2,433,375	2,157,852	1,814,237	− 343,615	− 619,138
Total, Class II	56,920,431	54,391,665	36,292,442	− 18,099,223	− 20,627,989

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship and is known as the "free on board" value.

Values (f.o.b.) of **Exports**—*Contd.*

	Year ended December 31,			Increase or Decrease, 1940—1939	Increase or Decrease, 1940—1938
	1938	1939	1940		
	£	£	£	£	£
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel...	3,291,723	4,000,147	2,202,571	− 1,797,576	− 1,089,152
B. Pottery, glass, abrasives, &c....	9,610,109	9,453,228	11,503,555	+ 2,050,327	+ 1,893,446
C. Iron and steel and manufactures thereof	41,555,579	32,831,605	31,051,503	− 1,780,102	− 10,504,076
D. Non-ferrous metals and manufactures thereof......	12,339,096	12,653,561	12,399,783	− 253,778	+ 60,687
E. Cutlery, hardware, implements and instruments	9,027,657	8,719,285	9,461,498	+ 742,213	+ 433,811
F. Electrical goods and apparatus	13,430,165	11,253,362	13,230,656	+ 1,977,294	− 199,719
G. Machinery	57,867,565	47,398,109	36,575,053	− 10,823,056	− 21,292,512
H. Manufactures of wood and timber	1,164,556	1,056,714	745,931	− 310,783	− 418,625
I. Cotton yarns and manufactures......	49,680,714	49,092,349	49,332,523	+ 240,174	− 348,191
J. Woollen and worsted yarns and manufactures	26,813,619	26,654,827	28,691,520	+ 2,037,193	+ 1,877,901
K. Silk yarns and manufactures...	5,502,161	5,904,435	8,669,794	+ 2,765,359	+ 3,167,633
L. Manufactures of other textile materials	10,657,365	11,105,713	12,407,553	+ 1,301,840	+ 1,750,188
M. Apparel...............................	8,515,263	8,251,598	7,514,673	− 736,925	− 1,000,590
N. Footwear	1,962,596	1,889,174	1,823,021	− 66,153	− 139,575
O. Chemicals, drugs, dyes and colours	22,060,176	22,788,185	27,669,786	+ 4,881,601	+ 5,609,610
P. Oils, fats and resins, manufactured	5,365,496	4,742,616	2,985,410	− 1,757,206	− 2,380,086
Q. Leather and manufactures thereof	3,943,101	4,098,944	3,691,530	− 407,414	− 251,571
R. Paper, cardboard, &c.	6,930,313	6,696,018	9,859,160	+ 3,163,142	+ 2,928,817
S. Vehicles (including locomotives, ships and aircraft)...	44,627,488	39,644,502	32,738,492	− 6,906,010	− 11,888,996
T. Rubber manufactures...........	1,649,695	1,430,721	1,885,883	+ 485,162	+ 236,188
U. Miscellaneous articles wholly or mainly manufactured...	29,249,323	28,482,181	31,520,303	+ 3,038,122	+ 2,270,980
Total, Class III	365,241,030	338,166,774	335,960,198	− 2,206,576	− 29,283,832
IV. ANIMALS, NOT FOR FOOD	679,364	683,601	824,443	+ 140,842	+ 145,079
V. PARCEL POST	12,017,472	10,572,786	6,654,657	− 3,918,129	− 5,362,815
Total.......................	470,755,320	439,535,710	413,084,205	− 26,451,505	− 57,671,115

Values (f.o.b.)* of* **Exports of Imported Merchandise**

	Year ended December 31,			Increase or Decrease, 1940—1939	Increase or Decrease, 1940—1938
	1938	1939	1940		
	£	£	£	£	£
I. FOOD, DRINK AND TOBACCO—					
A. Grain and flour	1,506,469	912,019	330,436	− 581,583	− 1,176,033
B. Feeding-stuffs for animals	67,945	81,900	47,804	− 34,096	− 20,141
C. Animals, living, for food	—	—	—	—	—
D. Meat	558,722	529,507	408,807	− 120,700	− 149,915
E. Dairy produce	736,371	538,714	116,424	− 422,290	− 619,947
F. Fresh fruit and vegetables......	1,324,581	1,152,148	485,595	− 666,553	− 838,986
G. Beverages and cocoa preparations	6,127,237	5,619,618	5,400,803	− 218,815	− 726,434
H. Other food	1,197,053	1,097,606	975,243	− 122,363	− 221,810
I. Tobacco	780,992	923,247	148,542	− 774,705	− 632,450
Total, Class I	12,299,370	10,854,759	7,913,654	− 2,941,105	− 4,385,716

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of **Exports** *of Imported Merchandise—Contd.*

	Year ended December 31,			Increase or Decrease, 1940—1939		Increase or Decrease, 1940—1938	
	1938	1939	1940				
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—	£	£	£	£		£	
A. Coal	—	—	—	—		—	
B. Other non-metalliferous mining and quarry products and the like..................	347,676	300,012	242,756	—	57,256	—	104,920
C. Iron ore and scrap	301	501	—	—	501	—	301
D. Non-ferrous metalliferous ores and scrap...............	911,147	529,970	343,940	—	186,030	—	597,547
E. Wood and timber	289,539	215,079	208,811	—	36,268	—	80,728
F. Raw cotton and cotton waste	1,253,572	1,157,375	512,120	—	645,255	—	741,452
G. Wool, raw and waste, and woollen rags..................	12,559,507	8,617,941	4,798,510	—	3,819,431	—	7,760,997
H. Silk, raw, knubs and noils......	22,069	18,183	1,745	—	16,438	—	20,324
I. Other textile materials	818,513	833,157	377,326	—	455,861	—	441,217
J. Seeds and nuts for oil, oils, fats, resins and gums......	545,250	521,088	509,551	—	11,537	—	35,699
K. Hides and skins, undressed ...	9,568,919	7,789,798	3,578,282	—	4,211,516	—	5,990,637
L. Paper-making materials.........	62,857	25,772	522	—	25,250	—	62,335
M. Rubber	2,695,097	3,617,806	1,241,264	—	2,376,542	—	1,453,833
N. Miscellaneous raw materials and articles mainly unmanufactured	1,146,432	896,698	634,032	—	262,666	—	512,400
Total, Class II...............	30,250,609	24,333,710	12,448,859	—	12,104,851	—	17,801,750
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—							
A. Coke and manufactured fuel...	—	11	1	—	10	+	1
B. Pottery, glass, abrasives, &c....	57,829	47,620	27,780	—	19,840	—	30,049
C. Iron and steel and manufactures thereof	210,100	85,597	46,556	—	39,041	—	163,544
D. Non-ferrous metals and manufactures thereof......	9,061,682	2,707,416	666,532	—	2,040,884	—	8,395,150
E. Cutlery, hardware, implements and instruments ...	728,043	608,133	279,909	—	328,224	—	448,134
F. Electrical goods and apparatus	136,357	112,540	49,284	—	63,256	—	87,073
G. Machinery	913,210	906,260	442,524	—	463,736	—	500,686
H. Manufactures of wood and timber	199,653	169,112	47,368	—	121,744	—	152,285
I. Cotton yarns and manufactures.....................	195,724	118,176	71,076	—	47,100	—	124,648
J. Woollen and worsted yarns and manufactures	445,009	375,765	274,012	—	101,753	—	170,997
K. Silk yarns and manufactures...	504,643	341,097	127,549	—	213,548	—	377,094
L. Manufactures of other textile materials	130,802	171,059	180,136	—	10,923	+	29,334
M. Apparel.............................	432,700	395,888	108,149	—	287,739	—	324,551
N. Footwear..........................	47,370	148,429	12,350	—	136,079	—	35,020
O. Chemicals, drugs, dyes and colours	462,430	473,420	596,976	+	123,556	—	134,546
P. Oils, fats and resins, manufactured	1,081,291	1,046,193	1,315,235	+	269,042	—	233,941
Q. Leather and manufactures thereof	902,466	565,746	398,191	—	167,555	—	504,275
R. Paper, cardboard, &c.	69,245	47,341	29,757	—	17,584	—	39,488
S. Vehicles (including locomotives, ships and aircraft)...	415,174	280,411	240,130	—	40,281	—	175,044
T. Rubber manufactures............	18,001	12,796	3,630	—	9,166	—	14,371
U. Miscellaneous articles wholly or mainly manufactured	2,234,783	1,126,509	705,757	—	720,752	—	1,529,026
Total, Class III	18,276,515	10,039,519	5,602,902	—	4,436,617	—	12,673,613
IV. ANIMALS NOT FOR FOOD	698,152	585,604	223,542	—	362,062	—	474,610
Total.........................	61,524,646	46,033,592	26,188,957	—	19,844,635	—	35,335,689

BANK OF ENGLAND

Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),

(000's omitted)

1	2	3	4	5	6	7	8
		ISSUE DEPARTMENT				COLLATERAL COLUMNS	
Liabilities		Assets					
Notes Issued	DATES (Wednesdays)	Govt. Debt (£11,015) and Govt. Securities	Other Securities	Gold Coin and Bullion	Silver Coin	Notes in Hands of Public	Minimum Discount Rate
£		£	£	£	£	£	Per cent. 2 (Oct. 26, 1939)
580,219	Jan. 3	576,313	3,026	219	661	547,427	
580,219	" 10	576,053	3,485	219	312	536,132	
580,219	" 17	574,963	4,526	219	511	527,449	
580,219	" 24	574,978	4,514	219	508	522,791	
580,219	" 31	574,956	4,503	219	511	527,722	
580,236	Feb. 7	575,019	4,471	236	510	531,105	
580,236	" 14	574,785	4,703	236	512	531,635	
580,237	" 21	574,383	5,103	237	509	529,974	
580,237	" 28	574,401	5,085	237	511	531,216	
580,237	Mar. 6	575,016	4,476	237	508	534,296	
580,237	" 13	575,995	3,493	237	512	534,900	
580,237	" 20	576,240	3,247	237	513	540,640	
580,237	" 27	576,250	3,239	237	511	543,106	
580,237	Apr. 3	576,276	3,216	237	508	542,443	
580,237	" 10	576,319	3,168	237	513	576,319	
580,237	" 17	576,460	3,029	237	511	537,477	
580,237	" 24	576,421	3,069	237	510	537,146	
580,237	May 1	576,187	3,354	237	509	541,042	
580,237	" 8	576,399	3,091	237	510	543,953	
580,237	" 15	576,362	3,108	237	510	546,415	
580,237	" 22	576,163	3,325	237	512	546,497	
580,237	" 29	576,202	3,285	237	513	556,863	
580,237	June 5	575,919	3,569	237	512	569,262	
630,237	" 12	626,224	3,262	237	514	578,365	
630,237	" 19	626,296	3,194	237	510	589,051	
630,237	" 26	626,195	3,296	237	509	602,154	
630,237	July 3	626,731	2,758	237	511	608,184	
630,237	" 10	626,648	2,841	237	511	610,378	
630,237	" 17	625,863	3,626	237	509	608,917	
630,237	" 24	625,828	3,662	237	510	607,592	
630,237	" 31	625,906	3,582	237	512	609,540	
630,237	Aug. 7	626,162	3,327	237	511	613,671	
630,237	" 14	626,648	2,838	237	511	609,585	
630,237	" 21	626,729	2,762	237	509	610,042	
630,237	" 28	626,736	2,751	237	513	609,997	
630,237	Sept. 4	626,827	2,663	237	510	608,639	
630,237	" 11	627,061	2,676	237	263	627,061	
630,237	" 18	627,204	2,781	237	15	606,010	
630,237	" 25	627,151	2,833	242	16	604,764	
630,242	Oct. 2	627,064	2,928	242	8	605,255	
630,242	" 9	626,961	3,028	242	11	601,336	
630,242	" 16	626,905	3,083	242	12	597,721	
630,242	" 23	626,834	3,157	242	9	593,229	
630,242	" 30	626,813	3,180	242	7	591,571	
630,242	Nov. 6	626,762	3,230	242	8	593,490	
630,242	" 13	626,707	3,285	242	7	594,048	
630,242	" 20	626,588	3,402	242	10	592,652	
630,242	" 27	626,272	3,718	242	10	593,346	
630,242	Dec. 4	626,205	3,784	242	11	598,251	
630,242	" 11	626,265	3,726	242	9	604,540	
630,242	" 18	626,326	3,668	242	6	613,175	
—	" 25	—	—	—	—	—	

WEEKLY RETURN

for Wednesday in each Week, during the Year 1940

(000's omitted)

9	10	11	12	13	14	15	16	17	18
				BANKING DEPARTMENT					
Liabilities				DATES	Assets				Totals of Liabilities and Assets
Capital (£14,553) and Rest	Public Deposits	Bankers' Deposits	Other Deposits	(Wednesdays)	Govt. Securities	Discounts and Advances	Other Securities	Reserve (Notes and Coin)	
£	£	£	£		£	£	£	£	£
17,927	17,193	128,637	52,695	Jan. 3	153,136	4,557	25,058	33,701	216,452
17,954	27,853	115,719	42,500	,, 10	127,356	6,305	25,352	45,013	204,026
17,975	37,178	102,741	41,682	,, 17	117,196	3,767	24,753	53,591	199,307
18,005	56,687	80,131	43,020	,, 24	112,291	3,270	24,060	58,222	197,843
18,034	39,678	98,144	44,341	,, 31	119,356	3,064	24,527	53,250	200,197
18,067	28,626	108,650	43,751	Feb. 7	121,841	2,492	24,863	49,898	199,094
18,086	39,218	105,529	40,524	,, 14	126,136	4,737	23,106	49,378	203,357
18,115	48,587	97,164	40,361	,, 21	122,759	4,636	25,649	51,183	204,227
18,136	45,749	99,406	38,853	,, 28	127,122	2,781	22,235	50,018	202,146
18,152	22,498	128,899	40,415	Mar. 6	137,254	3,037	22,666	47,007	209,964
18,172	34,029	114,035	42,649	,, 13	136,354	3,218	23,769	46,144	209,785
18,187	49,484	98,178	41,756	,, 20	133,639	7,218	20,004	40,684	207,545
18,204	43,143	97,967	42,187	,, 27	134,189	6,094	23,026	38,192	201,501
18,226	23,390	120,768	41,417	Apr. 3	137,064	3,205	23,177	38,815	202,801
17,661	22,880	123,915	42,593	,, 10	137,224	5,544	22,461	41,800	207,049
16,673	28,654	114,958	39,736	,, 17	129,444	4,947	22,951	43,679	201,021
17,891	40,703	103,147	40,561	,, 24	130,649	4,860	22,823	44,070	202,402
17,704	19,755	125,447	44,886	May 1	138,978	5,931	22,578	40,305	207,792
17,719	33,144	108,125	44,970	,, 8	139,078	4,520	22,877	37,483	203,958
17,744	33,856	106,381	42,563	,, 15	139,093	3,877	22,493	35,081	200,544
17,767	32,784	103,051	46,079	,, 22	137,878	2,991	23,697	35,115	199,681
17,758	36,115	94,909	50,482	,, 29	148,903	2,882	22,728	24,781	199,294
17,812	13,612	118,790	49,614	June 5	161,733	2,890	22,808	12,397	199,828
17,834	34,891	103,158	48,360	,, 12	123,978	3,868	22,992	53,355	204,243
17,848	35,277	103,727	46,873	,, 19	130,553	3,536	26,975	42,661	203,725
17,885	57,965	82,749	50,332	,, 26	151,103	4,708	23,544	29,576	208,931
17,904	16,599	140,121	48,827	July 3	171,228	5,416	23,192	23,585	223,451
17,922	22,192	107,001	47,784	,, 10	146,653	3,875	23,143	21,228	194,899
17,913	56,038	79,166	51,234	,, 17	155,868	3,026	23,039	22,418	204,381
17,960	30,266	103,957	50,968	,, 24	154,103	3,144	22,239	23,665	203,151
17,963	22,680	106,263	52,271	,, 31	152,858	3,272	21,498	21,569	199,197
18,006	19,242	114,091	48,574	Aug. 7	157,328	3,128	22,025	17,132	199,913
18,032	30,092	107,616	48,781	,, 14	161,708	5,385	20,757	17,271	205,121
18,052	14,545	123,372	48,681	,, 21	151,813	8,833	22,426	21,578	204,650
18,067	8,828	118,656	51,803	,, 28	147,973	3,875	24,622	20,884	197,354
18,083	10,852	116,279	48,418	Sept. 4	146,003	3,865	22,906	20,888	193,662
18,091	13,178	107,706	50,036	,, 11	139,498	4,074	23,006	22,433	189,011
18,101	10,878	128,793	52,164	,, 18	157,823	3,727	23,261	25,125	209,936
18,116	13,526	115,980	51,896	,, 25	147,813	3,536	21,894	26,275	199,518
18,126	21,268	101,272	53,355	Oct. 2	142,563	2,795	23,019	25,644	194,021
17,644	19,086	115,299	51,973	,, 9	146,228	6,608	21,696	29,470	204,002
17,662	19,852	109,147	52,239	,, 16	138,998	5,392	21,554	32,956	198,900
17,681	23,685	105,141	52,340	,, 23	137,353	2,780	21,239	37,475	198,847
17,700	18,250	108,004	51,511	,, 30	130,038	2,997	23,278	39,152	195,465
17,718	12,937	118,233	49,425	Nov. 6	136,408	3,100	21,494	37,311	198,313
17,735	19,584	114,671	49,991	,, 13	139,808	4,229	21,066	36,878	201,981
17,752	22,386	112,407	51,400	,, 20	140,848	3,940	20,820	38,337	203,945
17,780	27,111	110,829	50,311	,, 27	137,848	6,942	23,892	37,819	206,031
17,807	21,953	105,789	51,007	Dec. 4	139,828	3,859	20,445	33,024	197,156
17,824	11,430	115,903	51,294	,, 11	140,833	3,918	20,824	26,876	201,451
17,847	12,021	129,273	52,664	,, 18	169,128	3,809	20,830	18,038	211,805
—	—	—	—	,, 25	—	—	—	—	—

FOREIGN EXCHANGES.—*Quotations as under*, LONDON *on Paris, Calcutta and Hong Kong ; New York on* LONDON, **1940.**

DATES	1 London on Paris Cables (middle rate)	2 London on Calcutta Demand (middle rate)	3 New York on London Cables (closing rate)	4 London on Hong Kong T.T.	5 Price per Ounce Gold Bars (fine)	6 Price per Ounce Silver Standard Bars (cash)
1940.	f. c.	s. d.	$ c.	s. d.	s. d.	s. d.
Jan. 11	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 10$\frac{1}{4}$
,, 25	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 9$\frac{13}{16}$
Feb. 8	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 9$\frac{1}{2}$
,, 22	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 8$\frac{1}{4}$
Mar. 7	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 9$\frac{1}{2}$
,, 21	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 8$\frac{11}{16}$
Apr. 4	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 8$\frac{3}{16}$
,, 18	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 8$\frac{7}{8}$
May 2	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 9$\frac{7}{16}$
,, 16	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 11$\frac{1}{2}$
June 6	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 11$\frac{3}{4}$
,, 20	176 $\frac{5}{8}$	1 6	4·03	1 3	168 0	1 10$\frac{3}{16}$
July 4		1 6	4·03	1 3	168 0	1 9$\frac{3}{4}$
,, 18		1 6	4·03	1 3	168 0	1 10$\frac{1}{2}$
Aug. 8		1 6	4·03	1 3	168 0	1 11$\frac{1}{2}$
,, 22		1 6	4·03	1 3	168 0	1 11$\frac{1}{4}$
Sept. 5		1 6	4·03	1 3	168 0	1 11$\frac{7}{16}$
,, 19		1 6	4·03	1 3	168 0	1 11$\frac{7}{16}$
Oct. 3		1 6	4·03	1 3	168 0	1 11$\frac{7}{16}$
,, 17		1 6	4·03	1 3	168 0	1 11$\frac{7}{16}$
,, 31		1 6	4·03	1 3	168 0	1 11$\frac{1}{2}$
Nov. 14		1 6	4·03	1 3	168 0	1 11$\frac{5}{16}$
,, 28		1 6	4·03	1 3	168 0	1 11
Dec. 12		1 6	4·03	1 3	168 0	1 10$\frac{7}{8}$
,, 26		1 6	4·03	1 3	168 0	1 11$\frac{1}{4}$

JOURNAL

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PART II, 1941.

THE FINANCING OF BRITISH AGRICULTURE

By M. G. KENDALL

ALTHOUGH the war has emphasized the importance of maintaining
a flourishing domestic agriculture, many people are still accustomed
to regard the agricultural production of the United Kingdom as a
minor item in our own industrial economy and a negligible item
compared with the big overseas producers of food. It is not, I
think, generally appreciated that in the immediately pre-war years
our agricultural output was greater in value than that of any
Dominion, with the possible exception of Canada, whose output
was about equal to our own. Both absolutely and relatively,
United Kingdom agriculture constitutes one of our biggest primary
industries, employing about a million men, producing annually for
sale goods worth about £285 millions and, of course, covering most
of the land area.   One would have expected that the financing of an
old-established industry of this magnitude would by now have been
thoroughly explored; but in fact, though the mechanism of the
financial operations of farming is fairly well understood, few branches
of agricultural economics are so deficient in quantitative informa-
tion.   In this paper I have tried to bring together such statistical
material as exists and to fill some of the gaps by estimates of a
greater or less degree of reliability—generally less.   It will be
evident in the sequel that a good deal of the information is in-
adequate; but I hope that some purpose will be served by an
examination of the subject, if only in indicating the lines on which
further enquiry might be conducted.

THE BACKGROUND

The Income and Expenditure Account of the National Farm

Before considering the individual farm enterprise it will be useful
to give some idea of the annual turnover of the National Farm and
the magnitude of its receipts and expenditure.   By "National
Farm" I mean the whole agricultural enterprise considered as one
big farm, inter-farm transactions such as the transfer of livestock or

sales of crops grown for animal feeding on farms being ignored.   I have attempted in Table I an Income and Expenditure Account for the immediately pre-war period.

Some of the estimates in this table are based on very inadequate material, and I am not prepared to maintain the accuracy of every figure; but the Account as a whole gives, I hope, a fair representation of the National Farm during the period 1937–39.   Some notes on the basis of arrival at the expenditure items are given in the Appendix, but two further points require explanation here.

TABLE I

Estimated Income and Expenditure Account of the National Farm

(Average 1937–39)

Income	£m.	Expenditure.	£m.
Sales of Products			
Livestock and livestock products	200	Labour	65
Farm crops	84	Rent and mortgage payments	33
Miscellaneous (seeds for export,		Feeding stuffs	65
etc.)	1	Fertilisers and seeds	9
		Taxes, rates, etc.	4
		Interest on loans, etc. ...	7
		Miscellaneous expenses (machinery, etc.)	20
		Balance	82
	285		285

(a) *Income.*

The income figure is based on official estimates of the agricultural outputs of England (including Wales), Scotland and Northern Ireland.   It includes agricultural and horticultural produce sold off farms for consumption elsewhere than on farms.   Allowance has been made for subsidies (but not for concealed forms of State assistance such as de-rating, which do not properly appear as income) and for a small group of commodities which, being produced after one census date and consumed before the next, do not appear in the annual returns on which the official estimates are based.   There is no allowance for items of income derived by farmers from other business or from non-agricultural sources associated with the farm, *e.g.* shooting rights, rents for electric pylons, occasional sales of gravel and chalk or profits from ancillary enterprises such as milk retailing.   This latter group of sources taken together would not, I think, total more than two or three million pounds.*

* In some parts of the country, notably Devon and Cornwall, one of the most profitable cash crops in the summer is bed-and-breakfast.   I cannot estimate the revenue from this source, but it would not make any considerable contribution to the total of £285 millions, though some farmers would regard it as an important factor in their farm economy—like the Irishman's pig, it pays the rent.

(b) *Balance*.

This is the figure to which the fierce light that beats upon the profitability of farming is likely to be most severely directed. It is quite frankly a balancing figure, introduced to make both sides of the account add up to the same total, and has not been estimated from any data about farm profits. The sum of £82 millions (which allows for subsidies), if correct, would represent the farmer's and his family's remuneration for work and interest on invested capital. From it he has to feed, clothe and educate himself and his family, meet ordinary household expenses and so on. There are about 530,000 agricultural holdings in the United Kingdom, and the total thus represents an average of about £155 per holding; but I do not think an average of this kind means very much.* The Farm Management Survey, to which I refer again below, gave a figure of about £220 per farmer in England and Wales, which is probably much nearer the truth.

To illustrate the relation between agricultural and industrial finance one would like to complement Table I by a Balance Sheet for the National Farm; but after some trials I abandoned the attempt. Much of the capital invested in agriculture cannot be directly assessed, and the only way to value the land and permanent equipment is to capitalize the annual value on some conventional basis. Some general idea of the relationship between returns and investment may, however, be derived from official estimates in the Agricultural Censuses of 1925 and 1931 for England and Wales of landlord's and tenant's capital.†

TABLE II

Estimated value of agricultural land (including permanent equipment) and tenant's capital employed in England and Wales, 1925 and 1931. Rough grazing and specialist poultry and market garden holdings excluded.

	Capital value of land	Tenant's capital
	£m.	£m.
1925	815	365
1931	645	280

* The distribution of holdings according to size is J-shaped, the typical Pareto curve such as is given by income distributions. In the United Kingdom about half the holdings are smaller than 35 acres and 66 per cent. of the holdings are smaller than 50 acres. It is certain that a large number of these holdings are not real farms, that is to say are not economic units farmed for a livelihood, and the proportion may be anything up to 40 per cent. Evidently the arithmetic mean is of little significance in such cases as this, and the average per holding does not reflect the position on the average farm.

† Tenant's capital includes all the types of capital which in general practice are owned by the tenant, even on holdings when the occupier is his own landlord.

Unfortunately there are no comparable figures for Scotland and Northern Ireland and no estimates even for England and Wales subsequent to 1931 (which was far from a representative year). Only the broadest estimates for the United Kingdom in the pre-war year are therefore possible. Assuming that the 1937–39 values were intermediate between those for 1925 and 1931, making a proportionate allowance on an acreage basis for Scotland and Northern Ireland and adding about £50 millions for rough grazings and other land, I estimate that the capital value of agricultural land and equipment in the United Kingdom prior to the war was about £900 millions.

Tenant's capital includes (a) the value of live and dead stock at current rates, (b) tenant right valuation and (c) the amount of cash in hand necessary to meet out-goings for rent, wages, etc. On a similar basis I estimate that the total tenant's capital in the United Kingdom before the war was about £450 millions—about half the capital value of the land. In war-time, of course, both values would be higher.

If we assume that one-third of the landlord's capital is owned by farmers (an estimate based on figures given later), it would follow that the capital owned by farmers amounted to £750 millions. Interest on this at 4 per cent. would amount to £30 millions, and this, subtracted from the balance of £82 millions, leaves £52 millions as the remuneration to the farmer and his family for their labour, managerial and manual.

It may also be of interest to give at this point some data on the distribution of the net income of farming between farmer, landlord and tenant. By " net income " I mean the yield of rent to the landlord, wages to the labourers and earnings to the farmer for his capital and management, i.e. what is sometimes called " social output." The relative items on Table I are £33 million for rent and mortgage interest, £65 million for labour and £82 millions for the farmer, the percentages of the total of £180 millions being 18 per cent., 36 per cent., and 46 per cent.

These figures, however, hardly give an adequate picture of farms above 50 acres, being very much weighted by the smaller-sized holdings. More detailed figures are given by the Farm Management Survey and are shown in Table III.

These figures are not entirely representative, but I think they give a fairly accurate picture. On the smaller farms we expect the proportion of income accruing to paid labour to be lower, owing to the greater proportion of unpaid family labour on these farms. It is remarkable that on farms above 50 acres in area the proportions of the three participants in the net income do not vary very much

with size.   Very roughly it can be said that labourers get about half
the net income and that the remainder is divided equally between
landlord and farmer.   Where the farmer is also the landlord he gets,
of course, both shares.

TABLE III

*Percentage distribution of net income on certain farms in England and
Wales in 1937, according to size of farm*

Size group	Rent	Labour	Farm income
acres	%	%	%
0–	22	36	42
50–	25	44	31
100–	28	46	26
150–	27	46	27
200–	28	49	24
250–	28	52	20
300–	26	52	21
350–	27	52	21
400–	25	56	19
450–	27	51	21
500 and over ...	22	59	19
Average, all groups	26	50	24

SOME FACTORS AFFECTING THE FINANCIAL STRUCTURE OF
BRITISH FARMING

There are certain distinctive features of agricultural production,
particularly British agricultural production, which exert an im-
portant influence on its financial structure; and I proceed to examine
the most important.

(a) *Land-tenure Systems.*

One of the outstanding features of British agriculture is the
high proportion of farms which are tenanted.   Some comparisons in
this respect with other countries are given in Table IV.

TABLE IV

Proportion of farmers who are owner occupiers in various countries

Country	Proportion	Date of information
England and Wales	33⅓%	1931
France	75%	1929
Switzerland	83%	1929
Netherlands	56%	1930
Germany	89%	1933
Denmark	95%	1930
U.S.A.	58%	1930
Canada	80%	1931

The proportion of owner occupiers in this country is one of the lowest in the world, and consequently the relation between landlord and tenant is of particular importance to the British farmer. This is one of the reasons, though not, I think, the most important reason, why extensive systems of State credit for farmers in other countries have no counterpart in our own. For about two-thirds of British farmers the financing of land improvement and permanent equipment is not their own responsibility but the landlord's, and though the farmer is financially concerned to some extent through the rent, he does not have to find the capital himself.

This is not necessarily a social advantage, because cases occur in which a farmer is deterred by his landlord from carrying out structural alterations which might be in the national interest and in which the landlord will not execute works which ought to be carried out; but it does mean an important shift in the responsibility for agricultural capitalization from the occupier to one who does not in many cases earn his living by working on the land.

(b) *Agricultural risks.*

The constitutional pessimism of farmers (a favourite joke among people who have never had a year's labour wiped out by a few days bad weather) is based on the extreme risks to which agricultural production is subject. The weather, blight and disease combine to make enormous variations in returns from year to year even when prices are stable. From the financial standpoint the significant thing about farming risks is that they are mostly borne by the farmer himself. He can, and frequently does, insure against fire; but insurance against diseases, though accepted by some companies, carries a high premium, and most farmers prefer—one might almost say, are compelled—to carry their own insurance.

(c) *Farm organization and the absence of joint-stock farming.*

British farmers are traditionally individualistic. There are probably at least 300,000 farmers in the United Kingdom, a few farming several thousand acres, but the majority on holdings less than 100 acres in extent. Nearly every one of these occupiers either possesses or hopes to possess his business; and when he is operating on borrowed capital his main ambition is to free himself from the burden of debt. To an ordinary business man there is nothing objectionable in operating on share capital, and in fact it is a commonplace that the legislative sanction of joint-stock companies in the nineteenth century was one of the principal factors in the expansion of industry which took place at that time. But the British

farmer is conservative to the core, and to finance his enterprise by the issue of shares is for him a delegation of the absolute authority which he likes to exercise over his domain. He will, as a rule, borrow only with regret and with the intention of discharging his debt at the earliest opportunity.

This is probably the fundamental reason why there is very little joint-stock farming in this country, and little co-operative farming in England or Scotland. A few farming firms exist, of course, but they are exceptional, and are generally associated with an industrial business in some way or other—for example, some brewers grow their own hops and some bacon manufacturers their own pigs. A few farming families have turned themselves minto liited companies, but even in such cases the general practice, I think, is for the company to be private. I know of only one case in which the public is invited to subscribe share capital to a farming enterprise, and that is of a specialised nature.

Nor can it be said that there is much desire on the part of the public to contribute share capital; and the principal reason here, I think, is the risky nature of the enterprise. For many years now farmers have been complaining of their losses and the gradual depletion of their resources, and the strength of their case has been admitted in a series of subsidies and protective measures. These are not the circumstances in which an owner of capital is tempted to invest. Agriculture pays no regular dividends and is, I think, regarded by the ordinary investor as something of a gamble.

But even in the more prosperous times in the latter half of the nineteenth century there was not, so far as I am aware, any movement towards joint-stock financing, still less towards co-operative movements. In England co-operative agricultural societies have never flourished, though there are one or two notable exceptions. In Wales they have been much more successful—one may suspect ethno-psychological reasons as well as geophysical ones—but taken as a whole cannot, I think, be said to constitute an integral part of our agricultural life. Such a position stands in marked contrast to some of the European countries, such as Denmark, where farming is organized largely on a co-operative basis. The Dane co-operates because he likes it. The Briton co-operates only as a measure of self-protection. The failure of co-operative marketing schemes was one of the conditions which led to the Agricultural Marketing Acts, which empower a majority of producers to impose a marketing scheme on the whole, experience having shown that no voluntary organisation could survive " blackleg " competition.

(d) *The inter-farm variability of conditions.*

The classical constituents of production—land, labour, capital and management—are required on every farm, and the principal difference between agricultural and industrial enterprise is the greater emphasis to be placed on the land factor. From the point of view of a Government attempting to deal with agricultural policy and legislation there is one further important difference—the variation in the importance of these factors from one farm to another. The heterogeneity of British farming is enormous. Farms vary in size from subsistence holdings of an acre or two to ranches of several thousand acres. Soil varies from the rich peats of the Fen districts to the thin soil of the Welsh hills. Productivity may vary from £200 per acre in market gardens to a few shillings on poor grazing. Some farms are entirely arable; on others the farmer does not know how to use a plough.

Even on farms of similar type in the same district there may be sufficient variation to make all the difference between profit and loss. No study of agricultural finance can ignore these variations, and I proceed to examine some of those relevant to financial conditions.

(i) *Variation according to size of farm.* Table V illustrates the variation of rent, capital value and tenant's capital according to size of farm.

TABLE V

Rent, capital value and tenant's capital per acre in England and Wales in 1931 (rough grazings, fruit, vegetable and poultry holdings excluded)—from The Agricultural Output of England and Wales, 1930–31, *H.M. Stationery Office, Cmd.* 4605.

Size of farm	Rent per acre	Value per acre	Tenant's capital per acre	Ratio of value per acre to tenant's capital
acres	shillings	£	£	
1–	61	54	17	3·2
5–	49	44	14¾	3·0
20–	40	38	12¾	2·8
50–	32	29	11¼	2·6
100–	28	25	10½	2·4
150–	24	20	9½	2·1
300–	20	16	8¾	1·8
500 and over ...	15	12	8	1·5
All sizes, average ...	28	24	10¼	2·3

The general tendency for the smaller farms to be cultivated more intensively is clear, and it is worth noticing that the tenant's capital per acre diminishes more slowly than capital value as the farms increase in size—in other words, owner-occupiers of bigger farms

have a smaller proportion of their capital locked up in the land itself.

(ii) *Variation according to farming type.*   Some idea of the magnitude of variations in the importance of contributory items to receipts and expenditure can be obtained in England and Wales from the Farm Management Survey.*   Table VI shows the distribution of expenses and receipts on some farms in 1937.

TABLE VI

Distribution of receipts and expenditure on certain farms in England and Wales in 1937.

	16 farms in the Severn Vale, " predominantly dairying "	19 farms in East Durham, " mixed farming with dairying side"	23 farms on warps (Lancs. and Yorks), " mainly cash crop farming "
Receipts	%	%	%
Livestock	37·62	21·68	27·82
Milk	49·34	51·32	0·44
Wool and eggs ...	4·50	1·64	1·34
Crops	4·80	20·20	67·76
Miscellaneous ...	3·74	5·16	2·64
	100 00	100·00	100 00
Expenditure			
Livestock	17·47	20·78	15·75
Labour	17·25	24·27	25·83
Rent	15·03	12·35	10·09
Feeding stuffs ...	33·79	20·27	12·98
Fertilisers and seeds	2·01	5·85	17·68
Miscellaneous ...	14·45	16·48	17·69
	100·00	100·00	100·00

The distribution of expenditure between the constituent items does not vary so much from one type of farm to another as one might expect, though the relatively higher expenditure on labour, fertilizers and seed in the arable type is distinctive.   From the financial viewpoint perhaps the most interesting feature is the differences in sources of receipts, the dairy farms deriving half their income from milk, the arable farms two-thirds from crops.   The significance of this is that the milk income is regular all the year round, and, under our present organization, perhaps the most stable

* The Farm Management Survey is a State-financed investigation carried out by the eleven Advisory Agricultural Economists in England and Wales and the Agricultural Economics Research Institute at Oxford.   It covers about 2,000 farms distributed throughout the country, and began in 1934.   A Report on the first two years was about to be published by the Institute at the outbreak of war, but has had to be held back for reasons of economy.   I very much hope that after the war the mass of interesting statistical material in the reports will be made generally available.

source of income in the whole of farming; whereas receipts from crops, in the nature of things, only arrive after harvest. The arable farmer thus has to carry his production for a much longer period than the dairy farmer, and his need for short-term credit is correspondingly greater and, I believe, more difficult to meet. On the other hand, dairying is frequently mixed up with the production of fat or store stock, in which the farmer may have to carry his beasts for two years or more before realizing on them, and some types of dairying are very highly capitalized per acre.

The Farm Management Survey also provides some idea of the variation in tenant's capital between different types of farms, some typical figures being given in Table VII. The tenant's capital in this table is not quite the same as that of Table V, but the difference is not material for present purposes.

TABLE VII

Tenant's capital per acre at the end of 1937 for certain farms in England and Wales

Capital per adjusted acre *

Area	Livestock	Crops	Machinery and equipment	Total
	£	£	£	£
South Cambridgeshire ...	3·56	7·00	2·16	12·72
South Northumberland ...	7·04	0·70	1·25	8·99
Lancashire (poultry)	38·52	0·00	62·38	100 90
Vale of York	5·34	6·58	2·25	14·37
East Devon	7·73	1·43	1·78	10·96

* Adjusted acreage is the total farm area less rough grazings plus the equivalent of rough grazings in terms of average pasture, *i.e.* it attempts to reduce rough grazing to comparability with ordinary farming land.

(iii) *Variation according to standards of management.* One of the most striking things about the profitability of the farm enterprise is the way in which success depends on the personal factor. It is extremely difficult to reduce a discussion of this subject to numerical terms or to bring forward any decisive evidence to support general conclusions; but it appears to be true that even when general factors such as location, soil type, capitalization and so forth are constant there still remains substantial inter-farm variability in profit and loss which can only be attributed to the farmer's own ability. In every industry, I suppose, it is possible to point to men who, by sheer personal merit, have succeeded where others failed. It is certainly possible to do so in agriculture, and I believe that ability is one of

the most important factors in farming success. That is not to say, of course, that farmers in difficulties have only their want of skill to blame. There are some circumstances which even genius cannot overcome, and probably during agricultural depressions our country churchyards are full of village Hosiers and mute inglorious Bomfords who would have succeeded if they had only been given a fair chance. But farming is an elastic enterprise which gives great scope for foresight, judgment, adaptability and all the other factors which contribute to business ability. And the moral of that is that many agricultural creditors prefer to rely on their knowledge of the farmer's capacity and character rather than a detailed scrutiny of his accounts.

(e) *The ability to live on capital.*

On a prosperous farm a good deal of the annual expenditure is incurred on the maintenance of farm buildings and equipment, particularly hedges, ditches and drains. In a time of depression the farmer can, and often does, effect temporary economies by neglecting this work, and by similar activities such as cutting down his stock (and thus depleting fertility), overcropping land which ought to be rested, neglecting cultivations and so on. In short, he can live on his capital. Since the full effect of this type of neglect is not felt for several years, he can carry on in this way for some time. If the depression is not a serious one, or he was fairly well equipped to withstand it, he may, when the better times come, be able to recover lost ground and carry on as before; but there will be some individuals of meagre resources who will run heavily into debt, seriously impair the productivity of their holdings and reach a stage in which they have either to relinquish their impoverished farms to new occupiers or to spend many years of struggle on a subsistence level—generally the latter.

The tenacity of the farmer in hanging on to his farm at all costs is thus apt to result in a chronic local condition of under-capitalization in agriculture. The effect is enhanced by the optimism of new entrants, who frequently take over a holding with insufficient capital in the hope of being able to make enough profits to put back into the business to restore the farm to proper condition. Even in prosperous times there will be a marginal fringe of farmers, and therefore of farms, in such circumstances; and when there is a series of depressions or the structure of agriculture is undergoing secular changes the numbers may be very considerable. When this kind of thing happens in industry the impoverished units usually drop out and their remaining business is absorbed by other enterprises; but

impoverished pieces of land are not readily absorbed, and thus local agricultural impoverishment, sometimes acute, is always chronic.

In the last twenty years there has, I believe, been a tendency for agricultural impoverishment in this country to increase. The effect has not been, however, to result in derelict farms so much as in derelict fields. In certain hard-hit areas farmers have been pushed to the extreme and have deliberately allowed part of their holdings— the more outlying or less fertile fields—to fall out of cultivation in order to concentrate their limited resources on the remainder. The depressed agricultural areas of Britain are not composed of derelict farms—though such exist—but of impoverished farms with derelict fields, and the problem of dealing with them is thereby made more difficult. I do not want to paint a gloomy picture of agricultural conditions, and the above remarks are not to be intepreted as meaning that there is an extensive amount of distress among the farming community; but I emphasize that there are problems in this situation which require active and skilful handling.

AGRICULTURAL CAPITAL AND AGRICULTURAL CREDIT

I now turn to a discussion of the financing of farming and farming operations under the headings of Capital and Credit.

It has already been noted that the value of capital and permanent equipment in pre-war years was about £900 millions. Of this about two-thirds is not owned by the farmer, but by the landlord. An adequate discussion of the present position of landlords, and in particular their contribution to agriculture and the effect of taxation on that contribution, would require a paper in itself, and I content myself with noting that they do play an important part in providing agricultural capital.

The remaining third of the capital and the £450 millions of tenants' capital has to be provided by farmers themselves. How much of the total of £750 millions they contribute from their own resources and how much is borrowed remains a mystery. There can, however, be no doubt that a good deal of it is borrowed, some by mortgage on the land and property itself, some on the strength of other assets, and some by hire-purchase. When dealing with tenant's capital, which includes such things as cattle and crops, it is not always easy to draw the line between capital and credit. A confusion between the two has led to a good deal of misunderstanding, and I return to the point below.

Agricultural credit may be classified as "long term," "intermediate" and "short-term," according to the purposes for which the credit is required. It is not always easy to draw a rigid line of demarcation, but the classification is a very useful one in practice.

Broadly speaking, short-term credit is that required for the financing of the current year's farming operations, and particularly the growing of crops, and is expected to be liquidated after harvest; intermediate credit is required for farming operations of a rather longer period, and would cover the purchase of livestock and machinery; and long-term credit is required for carrying out works, improvements or structural alterations on the land itself. Generally speaking, short-term and intermediate credit are provided by banks and merchants in the form of overdrafts or unpaid accounts, and long-term credit is provided by banks, finance corporations or private lenders against the deposit of title deeds or the execution of mortgages or land charges.

Long-term credit.

Credit provided by the execution of a mortgage may be obtained privately, through banks, or through special bodies, such as the Agricultural Mortgage Corporation in England and Wales and the Scottish Agricultural Securities Corporation in Scotland. The extent to which mortgages exist is not known, but they must be very common. I do not think it is an overstatement to say that at least 50 per cent. of the land in England and Wales is under mortgage. Most of this is to private persons. Some may be to the banks, though I believe the more usual practice is for banks to allow overdrafts against the deposit of title deeds. The remainder is to the Mortgage Corporation, and it is here alone that any definite information is available.

The Corporation's mortgages are distributed all over England and Wales and, so far as the prevalence of mortgage is concerned, I see no reason to doubt that they are representative. There are relatively more mortgages on the bigger farms, as illustrated in Table VIII.

TABLE VIII

Percentage distribution of mortgages of the Agricultural Mortgage Corporation according to size group, compared with percentage distribution of numbers of holdings

Size, acres	% of farms mortgaged to A.M.C. falling into size category	% of number of holdings in England and Wales falling into size category
1–	25	61
50–	22	17
100–	47	21
500–	4	1
1000 and over	2	—
	100	100

This is to be expected of mortgages generally, but in this particular case the effect may be due to the fact that the Corporation can handle bigger loans than private persons.

'In July 1940 the Agricultural Mortgage Corporation had on first mortgages about £8,620,000 on 637,000 acres, an average of £13 10s. 8d. per acre. If we apply this rate to half the cultivated area of crops and grass in Great Britain we reach a total loan on first mortgage of about £200 million. It is, however, not uncommon for second mortgages to be executed, the Agricultural Mortgage Corporation lending only up to two-thirds of the value of the property, and the figure is to be increased, say to £250 millions. This is obviously only the roughest estimate, but it is the best I can propose.

The principal difficulty in assessing the effect of mortgage loans on agriculture is the absence of knowledge about what the loans are used for. There is nothing to prevent a mortgagor from disposing of the money in any way he likes, and it seems very doubtful whether the £250 millions all represents money which has been invested in farming. Much of it undoubtedly has, but it is impossible to say how much. Nor is it clear how much of the burden of interest and redemption of mortgage is borne by farmers, though here again a great deal of it must be so borne. The whole position is exceedingly obscure, and any conclusions based on the figure I have given must necessarily be very tentative.

There is also in existence a type of long-term credit used for carrying out semi-permanent improvements such as drainage and the erection of barns. The principal difficulty in giving such credit is to provide security, the improvements being irrecoverable in the sense that if the loan is not repaid there are no assets to seize or sell and no property on which to foreclose. A series of Acts from 1864 onwards have dealt with this problem. It is open to a *landowner* to apply for a loan to carry out certain specified improvements, and the redemption of the loan, if approved, becomes a first charge on the property. Two bodies in England and Wales handle this business, the Lands Improvement Company and the Agricultural Mortgage Corporation. In Scotland there is very little business of this kind handled by the L.I.C. or the Scottish Agricultural Securities Corporation, and although I believe the banks do a certain amount, I do not know how much. The toal loans of the Lands Improvement Company outstanding on 31st June 1939 amounted to £1,850,000 and those of the Agricultural Mortgage Corporation on the same date were £87,800.

Short-term credit.

The principal sources of short-term credit are the joint-stock banks and merchants and auctioneers. Most farmers nowadays

have a banking account, and many of them obtain credit in the form of overdrafts. Advances to agriculture in the pre-war period by the banks operating mainly in England and Wales are believed to have been about £50 millions,* though this figure would fluctuate seasonally. Perhaps the comparable figure for the United Kingdom would be £70 millions. Not all of this, however, is short-term credit. Some of it will be advances of a long-term character against collateral such as title-deeds; and some again will be revolving short-term credit, renewed from year to year and thus long-term in essential character. At a guess I should say that about a half of the total is short-term credit in the sense defined above.

The volume of credit given by merchants and auctioneers is quite unknown, but it must be very large. It is a common practice for a farmer to obtain seed or store cattle and to defer payment until the crop is harvested or fat beasts sold as the case may be. It seems fairly certain that the total amount of credit provided in this way —true short-term credit—is at least as large as that provided by the banks, and possibly it may be even greater. Every type of farmer is affected, the arable farmer through seeds and fertilisers, the grass farmer through feeding stuffs and store animals.

There are two other sources of short-term and intermediate credit which should be mentioned. The first is the deferment of rent payments, many farmers leaving the payment of their rent until some weeks or months after it is due. The practice is so common that perhaps farmers will find fault with me for describing it as credit at all. The second is the hire purchase of implements and stock.

In recent years there has been an increase in the practice of buying by hire purchase not only implements and machinery but store stock and dairy cattle, particularly the latter. What the volume of business amounts to is unknown, but it must be considerable—running, I should say, into millions of pounds. It is possible that the Hire Purchase Act may have acted as a deterrent to the expansion of this type of business, but one cannot be sure.

In fact it will be evident enough from what I have said that factual evidence in this field is very meagre. The farmer is very reluctant to disclose his financial circumstances, and the lending agents are equally inclined to reticence. Farming interests often claim that their credit requirements are not being adequately met. The banks are accused of witholding loans from credit-worthy borrowers and of charging too high rates of interest; the merchants

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* In 1923 the joint-stock banks had on loan about £43½ millions to agriculture. £26 millions of this sum was in respect of land purchase and the remainder on short-term loan. At the middle of February 1940 the total amount was £53 millions (Hansard, 2nd July, col. 679).

and auctioneers are reviled on the grounds that they use their credit business to " get a grip on the farmer " and force him to sell through their agency. Hire-purchase companies are accused of charging extortionate rates of interest, and so on. A good many of these complaints are, I think, unjustified, but whatever the rights and wrongs of the matter, their net effect is to create an aura of bias round the subject which makes dispassionate appraisal very difficult and representative factual data almost unobtainable.

State measures for agricultural credit.

From what has been said above it will be evident that the great bulk of agricultural credit is provided from private sources, and in fact, with one or two negligible exceptions, there is no Government credit for agriculture. This situation is an integral feature of our agricultural economy, and forms a marked contrast with most other European countries and the U.S.A. Where the Government in the past has intervened to assist farming its general policy has been that a healthy agriculture can attract all the necessary capital and credit from private sources in competition with other industries, and that the primary problem is to create the requisite healthy state. In consequence there are very few Acts on the Statute book dealing with credit; and even these are mainly devoted to greasing the wheels of the existing credit mechanism, not to providing State funds for the credit service of agriculture.

I have already referred to the series of Lands Improvements Acts beginning in 1864. The primary object of this legislation (which has been quite successful) was to provide security for loans for semi-permanent and permanent improvements to land in the form of first charges. There were no other Government measures until 1923, when an Act was passed to enable loans to be advanced from the Public Works Loans Fund for the purchase of land. This Act was a purely temporary measure, and is to be considered as one of the immediate post-1914-war agricultural measures which are now admitted not to have been outstandingly successful. It is now only of historical interest, except to the farmers and the Departments concerned in the repayment of the loans.

During the period following 1923 there was considerable agitation for the State provision of agricultural credit, and a report of a committee set up by the Ministry of Agriculture * was the forerunner of the Agricultural Credits Act of 1928. The Act was divided into two parts, the first dealing with long-term credit and the second with short-term credit. Part I enabled the constitution of the Agri-

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* Ministry of Agriculture and Fisheries Economic Series, No. 8, 1926. The report is published by H.M. Stationery Office, but is out of print.

cultural Mortgage Corporation, a company with a share capital of £650,000 owned by the joint-stock banks, formed to lend money on agricultural mortgages. The Corporation raise their funds by the issue of debentures in the open market, and have in fact raised about £10 millions in this way. The Government is not directly concerned in the operations of the Corporation, but made contributions of £10,000 a year to their working expenses for the first ten years of operation (1929–1939) and also made a loan of £650,000 for the establishment of a Guarantee Fund to safeguard the interest on debentures. A similar body, the Scottish Agricultural Securities Corporation, was formed in Scotland with a share capital of £100,000, a present debenture stock of £500,000, and a Guarantee Fund of £100,000.

The attraction of the mortgage loans offered by these Corporations was the long period of repayment, 60 years, and the guarantee which the borrower had of not being suddenly subjected to a calling up of the loan before the expiration of that period. The Corporations began with great success, but unfortunately in 1932 the English Corporation ran into difficulties. A debenture issue at $4\frac{1}{2}$ per cent. was made just before the War Loan conversion of that year, and the resulting fall of interest rates embarrassed them, and, notwithstanding a reduction of the interest rates on new loans to $4\frac{1}{4}$ per cent. the Corporation's business suffered. While the Government contribution of £10,000 a year was being paid the Corporation avoided losses; but in 1939 it became evident that they could not continue doing so, and a clause was inserted in the Agricultural Development Act of that year enabling Exchequer payments to be made not exceeding £60,000 per annum to keep them going until such time as their debentures could be redeemed.

Part II of the Agricultural Credit Act of 1928 made it possible for a farmer to execute a floating charge on his farm chattels in favour of an approved bank. The intention was good, but this part of the Act has never been a success. The attitude of the banks cannot be described as more than lukewarm, and it does not appear that farmers were much more enthusiastic. There are only a few charges registered under Part II in existence at the present time in England and Wales and none in Scotland.

This was the position at the outbreak of war. I refer below to the measures which have been taken in war-time.

THE PROBLEMS OF AGRICULTURAL FINANCE

To summarize the foregoing figures very briefly, we might say that British agriculture, with a fixed capital of about £900 millions, a tenant's capital of about £450 millions and an annual output of

about £285 millions, bears a large part of a mortgage of £250 millions and interest on bank advances and merchant's credit of about £100 millions. (At the risk of being tedious I am compelled in my own defence to reiterate that these are very rough estimates.) Is this satisfactory? Broadly speaking I do not consider that there are any grounds for alarm and despondency in the situation. To some extent it is a good sign that an industry can bear a considerable volume of debt. There are, however, agriculturalists who regard any debt as an intolerable burden and allude to present mortgages and interest payments, in standard bucolic imagery, as a millstone round the farmer's neck which must be removed if agriculture is ever to flourish again. My own view is that this is an unwarrantable generalization from particular cases. There undoubtedly are farmers who are labouring with a heavy burden of debt; but that farmers as a whole are unduly hampered in their normal farming operations by debt or lack of credit may be doubted. They could all probably increase their production, and could certainly increase their profits if the burden of indebtedness were removed; but there are many of us in that position.

To some extent one's attitude towards the need for further credit and capital is dictated by one's conception of the proper place of agriculture in our economy. If it is held that agriculture should be allowed to find its economic level under the full pressure of external competition, no further provisions are necessary. On the other hand, if it were desired to increase agricultural production by a very great amount, undoubtedly some sort of financial assistance would be required, though it need not take the form of the direct furnishing of capital or credit by the State. I will try to describe the position as it appeared in 1937–39, uncoloured by considerations of defence. The war has made a tremendous break in the continuity of our agricultural development, and it seems likely that when it ends many agricultural problems will have to be considered *de novo*; but there is nevertheless a good deal to be learnt by an analysis of pre-war conditions.

We may consider the financial circumstances of British agriculture between 1918 and 1939 as a series of short-term movements imposed on a substantial trend. For about fifty years we have been steadily abandoning arable in favour of grassland farming. Our production has switched from cereals to livestock products, particularly milk. Large numbers of men have left agriculture, and some land has gone out of production altogether. Under the pressure of overseas competition we have transferred production from the more vulnerable commodities to those in which we have a natural advantage—milk, meat, fruit, vegetables and eggs (which,

incidentally, are those with the greatest protective value in the nutritional sense). Our farms have tended to become more specialized, and consequently individual farmers are more susceptible to price variations of particular commodities. Our output has increased, but so has our dependence on imported animal feeding stuffs.

Compared with urban industry perhaps this change has been slow; but it is quicker than is generally thought—for example, the production of eggs in England and Wales increased from 960 millions in 1908 to 2,616 millions in 1938, and the arable acreage declined from 11·4 millions in 1908 to 8·9 millions in 1938.

A movement of this magnitude requires a certain amount of financing, but relatively speaking is not of the dislocating type. I do not think farmers have had much difficulty in switching from arable farming to dairying, though demands for capital to acquire dairy stock have been considerable. The net effect of the long-term trend has not, so far as I can see, brought about any new weakness in the financial position of agriculture, though there may be cases where existing weaknesses have been revealed or increased.

But a series of short-term events in the last twenty years have certainly left their mark. In the first place, many farmers bought their holdings on mortgage at high prices after the last war and have been struggling with the burden of debt ever since. A good many of them have by now either found their feet or gone under; but their passage has had a considerable effect on the land. Secondly, the depression of 1931, one of the worst in farming history, has brought into play the factors mentioned above and left us with a few areas which might be called depressed. There are no vast tracts of land lying derelict to compare with the industrial Special Areas in 1936; but there are districts containing a proportion of distressed farms.

Added to these effects, which are a direct consequence of our recent agricultural history, we have to take account of the tendency mentioned above, which I believe is operative at all times under a system of private owner-farmers, namely the chronic under-capitalization due to poor farmers holding on to enterprises which they ought to relinquish and the entry of new farmers with insufficient resources. However prosperous agriculture as a whole may be, the net effect of these circumstances will be to result in a certain amount of local impoverishment. Assuming that this state of affairs cannot be contemplated with indifference, what is the remedy to be and where is it to be applied?

At this point I endeavour to remove a misunderstanding which has created some confusion among agriculturists. The remedy generally proposed by farming interests to deal with under-capital-

ization is the supply of cheap credit. By cheap credit is generally understood the supply of funds at a lower rate of interest than is obtainable in the open market, and it is almost invariably a feature of schemes for supplying cheap credit either that the Government finds the difference or that it guarantees the loan, or both. In other words, the State is to assist the provision of credit either directly by Treasury subvention or indirectly by lending its own credit-standing.

This is certainly one way of assisting agriculture, but I do not think it is a good way. The state of under-capitalization may be likened to the condition of anæmia in the human body. The condition may be palliated by the transfusion of new blood, and if it is due to loss caused by non-recurring accidents, a permanent cure may result; but if the condition is chronic, transfusion, though sometimes necessary in bad cases, is not a cure. If under-capitalization is chronic—and I think it is—the constant provision of new capital at uneconomic rates will be merely palliative. A true solution of the problem lies in removing the cause of the under-capitalization.

If this is true, the solution of such financial problems as exist in agriculture under our present organization would appear to require three main types of measure.

(a) In the first place, it is necessary to protect agriculture from the violent price changes which contribute substantially to, if they are not the primary cause of, agricultural depressions. How this protection is to be given I need not stop to examine, but experience of the last few years suggests that several types may be necessary—producers' organizations, regulation of market supply, and perhaps production control. There is, of course, always something to be said for letting economic events take their course, but I hardly think the most ardent exponent of *laissez faire* would deny the necessity of doing something to insulate farming from the effects of price changes such as occurred from 1929 to 1931.

(b) Secondly, the existing machinery for the provision of credit may require some greasing. It is one of the farmer's grievances that his security, though real enough, is too intangible to appeal to the joint-stock banks, and that consequently he does not get as much accommodation as he is entitled to. This, I think, is the idea behind proposals which have been made for the formation of agricultural banks : that they can gauge credit-worthiness better than the joint-stock banks and give a greater volume of credit on the same security.* It may well be that something could be done to

* It is said, though I do not know with what justification, that the tendency towards greater administrative control from headquarters which has evinced itself in the banks in recent years has prejudiced agriculture. The claim is that the old type of bank manager, with extensive personal knowledge of the

increase credit accommodation by a closer liaison between banking and farming interests. I refer below to some war-time measures which have been taken for that express purpose.

(c) Thirdly, it is necessary to do something about the farmer who is deliberately living on his own or his landlord's capital and mining the productivity of his soil. An ordinary business man who lives on his capital may not do such social harm; when he disappears, his business disappears with him. But when a bad farmer goes out of business he may leave behind him a worn and wasted holding which becomes a national liability. It would not be proper for me to suggest ways of dealing with this problem, but several ways will suggest themselves to the reader. In war-time, when personal considerations are subordinated to an unusual extent to the national interest, the problem of the incompetent occupier becomes of particular importance and the experiences gained during the present war may be of great value in subsequent years.

War-time measures.

In the last war it was not until 1917 that a campaign for the increased home production of food was begun on any large scale. This time a campaign had already been worked out in some detail when war broke out, and was launched at once. In the first year of war we ploughed up about two million acres of grassland, and in the second year we are aiming at ploughing up about the same amount. Demands on our shipping for war materials have entailed a reduction of imported animal feeding stuffs, and farmers have had to grow more of their own requirements and make feeding economies to redress the balance. More recently the minimum agricultural wage rate has been raised to 48s. per week. The effect of these measures on our agriculture has been profound.

The Government have recognized that the ploughing-up campaign would make a considerable demand on the farmers' resources, and a variety of measures have been adopted to meet the situation. Grants have been given for ploughing up, field drainage and ditching. County Committees are empowered to assist farmers by the hire of tractors and agricultural machinery and by carrying out essential farming operations such as threshing. Prices have been raised and revised from time to time to keep in step with costs of production. Concurrently with the raising of the minimum wage-rate steps have been taken to safeguard the supply of agricultural labour.

farmers in his district and a greater measure of autonomy, could safely give better accommodation than his modern counterpart who may have to refer all doubtful cases to headquarters. I have never seen any evidence to show whether this is true or not.

So far as finance is concerned, the Government has relied mainly on the pre-war machinery for the provision of credit from private sources. It has been held that if agricultural conditions, and particularly prices, are satisfactory, the farmer in war-time will be able to get all the help he needs from banks and merchants precisely as he used to do. For the great bulk of farmers this belief has been justified. I think it is true to say that at the present time the credit requirements of agriculture, broadly speaking, are being met.

There are, however, cases which require special attention. Some farmers cannot get credit from normal sources, and sometimes the reason is not that they are an uncommercial risk. To cover such cases an Agricultural Requisites Assistance Scheme has been introduced. In the English form of the scheme a County War Agricultural Executive Committee may provide a farmer with articles or services (but not cash) needed for the food-production campaign. Such requisites include, for example, seeds, fertilizers, feeding stuffs, fuel and contract services for cultivating, harvesting and threshing. The farmer executes a Repayments Agreement undertaking to repay the cost of the requisites and, in default, empowering the Government to tap at the source various payments due to him either from the Government itself (*e.g.* on livestock bought by the Ministry of Food) or from the Milk Marketing Board. Thus the Government is enabled to assume risks which are not always acceptable to private lenders. In Scotland the scheme is slightly different, the banks opening a Requisites Account on which the farmer can draw for approved requisites, and an undertaking being executed by the farmer to pay certain receipts into the account.

The volume of business undertaken under the Requisites Scheme is not large,* and was never intended to be so; but the Scheme has been successful in dealing with a number of difficult cases and is a very useful supplementary measure particularly adapted to war-time conditions.

Early in the war the Minister of Agriculture approached the joint-stock banks and pointed out that agriculture would probably be requiring increased accommodation to meet its war-time programme. The banks responded at once by an undertaking that they would do all in their power to assist. More recently further steps have been taken in the same direction. At the Minister's request the banks have appointed local liaison officers who can discuss with County War Agricultural Executives Committees any cases of difficulty arising in their areas. One may express the hopes that

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* From the inception of the English Scheme in March, 1940, up to the end of February, 1941, requisites costing about £160,000 had been supplied to about 1400 farmers.

this measure will not be allowed to lapse at the end of the war. It should be extremely useful, not only in bringing to the notice of banks cases in which they can provide further assistance, but in removing some of the misunderstandings which inevitably arise between farmers and bankers from time to time.

In conclusion I would like to express my thanks to some of my colleagues in the Agricultural Departments who have read this paper in draft and made a number of criticisms and suggestions, particularly to Mr. J. H. Kirk and Dr. W. F. Darke of the Ministry of Agriculture, the latter helping me a good deal in the difficult and hazardous task of compiling the Income and Expenditure Account of the National Farm, and to Mr. W. H. Senior and Mr. D. A. E. Harkness of the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland respectively, who have kept me from error when I ventured on to their territory.

APPENDIX

Notes on the figures given in Table I

As a general comment on these figures I should explain that it was found impossible to split them between the three constituent countries of the United Kingdom. Some of the estimates, and in particular those of feeding stuffs, are based on import figures, and once the material concerned has crossed the customs boundary its destination is indeterminate. No doubt estimated allocations could be made, but I did not consider that the labour involved would be repaid by the results.

Labour. £65 millions.

Mr. R. J. Thompson in Part IV of the *Journal* for 1937 (p. 606 *et seq.*) estimated the annual labour bill for England and Wales in 1931–3 to be £52·6 millions, and in 1936 to be under £50 millions. This was a very careful estimate, and may be regarded as definitive. If we grade up £50 millions proportionately to the number of workers in the United Kingdom and England and Wales, we reach a figure of about £62 millions. Since 1936 men have left the land, but wages and overtime payments have risen. On the whole I think the latter will have slightly outweighed the former, and I therefore round up the figure to £65 millions.

Rent and Mortgage Payments. £33 millions.

An inquiry by the Ministry in 1938 gave an average rent per acre in England and Wales of about 21s. This, however, is probably on the low side for the country as a whole, since it referred to the larger farms. Table V gives an average, based on crop reporters' estimates, of 28s. per acre for 1930–31, which in turn I should regard as on the

high side. Taking a mean figure of 24s. and applying this to the adjusted acreage of crops and grass in the United Kingdom, 36 millions, we reach a rental figure of £43·2 millions. (The gross Schedule A assessment for the United Kingdom in 1937–38 was £48·5 millions, but this includes a certain amount of property which is not farmed.)

We may suppose that only two-thirds of the acreage is rented, and thus the rent paid on that acreage would be about £28·8 millions. For the remainder, assuming that half is mortgaged up to two-thirds of its value and that the mortgage payments approximate to the rent, we reach a figure of $£14·4 \times \frac{1}{2} \times \frac{2}{3} = £4·8$ millions; and adding this to £28·8 millions, a total of £33·6.

As a very rough check on the figure of £4·8 millions, it is estimated in the text that the total mortgage amounts to between £200 and £250 millions. Interest and redemption might amount to between £12· and £15 millions, and of this one-third – between £4 and £5 millions—would be borne by farmers themselves. I allowed this to influence me so far as to round down the figure of £33·6 to £33 millions.

Feeding Stuffs. £65 millions.

The Report of the Food (Defence Plans) Department –now the Ministry of Food—for the year ended December 31st, 1937, gives estimates for 1934–36 of consumption of animal feeding stuffs other than those wholly home produced. These estimated quantities, valued at 1937–39 wholesale prices, have a value of £60·5 millions. This includes a certain amount, but not a large amount, of home-grown material which should be excluded. On the other hand, farmers' costs include such things as carriage, and valuation at wholesale prices underestimates the true amount; and since 1936 our dependence on imported feeding stuffs increased. The estimate has therefore been raised to £65 millions. This figure, of course, relates to the National Farm, and therefore does not include home grown feeding stuffs.

Fertilizers and seeds. £9 millions.

Estimated quantities of fertilizers used in 1937–39 were valued at prices obtaining in those years, giving a total of £6·7 millions. An extra £2 millions was allowed for seed and the figure rounded up to £9 millions.

Taxes, etc. £4 millions.

This is a very difficult item to estimate, and the figure is largely of a token character. I do not think farmers pay more than about £1 million in income tax, and I have no means of ascertaining their annual payments of drainage rates, Schedule A tax and any Tithe annuities to which owner occupiers are liable. The net Schedule A assessment in 1937–38 was £37·1 millions, and one third of this at 5s. in the £ would amount to about £3 millions; but since the Schedule A figure includes a number of non-agricultural properties,

such as sports grounds and woodlands, this is *probably* too high. I allowed £¾ for income tax, £2½ for Schedule A tax and rounded to the total of £3¼ millions up to £4 millions to allow for odd items such as drainage rates, etc.

Interest on short-term loans. £7 millions.

It is estimated in the text that bank advances amount to about £70 millions. Interest on this at 5 per cent. would amount to £3·5 millions per annum. I have assumed that interest on loans from auctioneers, merchants and hire-purchase companies would be as much again.

Miscellaneous expenses. £20 millions.

This also is a very difficult item. The size of the aggregate miscellaneous expenditure is apt to be somewhat of a surprise in farming—and indeed in most businesses. In the Farm Management Scheme this item may account for anything up to 20 per cent. of total expenditure. A few constituents of the whole may be isolated for separate consideration—*e.g.* expenditure on machinery would total several million pounds—but most of the miscellaneous items cannot be separately studied. Nor is it clear how much of the cost of these items is properly attributable to the farming enterprise—the motor car is a standard example of the difficulties in this field.

On the whole I think the miscellaneous expenses total at least £20 millions, and it is not unlikely that this figure is an underestimate.

DISCUSSION ON MR. KENDALL'S PAPER

(Comments received in writing.)

VISCOUNT BLEDISLOE : I have read Mr. Kendall's paper on the Financing of British Agriculture with considerable interest and with no small measure of disagreement. It has obviously involved much industry and research in its preparation, and contains many statements relative to the inherent weaknesses of our Agricultural structure and some recommendations (especially as regards the need for protecting farmers from violent price changes and for perpetuating into the peace period some of the financial props and directional contacts which the exigencies of war and national safety have called into existence) which experienced students of the woeful vicissitudes of British husbandry will cordially .endorse. But, as Mr. Kendall, with refreshing candour, admits that his estimates are " of a greater or less degree of reliability—generally less," and, in regard to his most important table of figures (upon which his conclusions are being founded) " are based on very inadequate material," it is not unfair to suggest that such conclusions and the resulting picture that he paints of British agricultural finance are apt to be

misleading. (Incidentally he confuses, in one part of his paper, a landlord's capital items and obligations with those of his farm tenant.) It is indeed on premisses admittedly unprecise and figures that are partly conjectural that he arrives at conclusions which, in my judgment, exhale a spirit of dangerous complacency with the unsatisfactory " status quo." He does not consider that " there are any grounds for alarm and despondency in the situation."

Having been a close student of agriculture in this and other countries of the world, as well as one of its active practitioners for nearly 60 years, I regard the present state both of the land and of the industry in Great Britain as justifying *both* alarm and despondency. For the last 30 years our agriculture has become progressively an indigent and a mendicant industry—the shuttlecock of myopic politicians—while other industries have piled up wealth at its expense. The economic stability of agriculture, as of other industries, should be judged not on a *datum* of Government subsidies, uncommercial credit, antiquated or defective equipment, and unremunerative and depressed rents, but, as in the days of Coke of Norfolk and the great outstanding farmers and stockbreeders of a century ago, on the amount and quality of the owners' capital (whether in money or in kind), the return that may be expected from it, and the sense of security and confidence that accompany and stimulate investment in it. None of these conditions can truly be said to exist in regard to our own agricultural industry and, unless and until they do, there can be no legitimate ground for complacency. The financial sterility of our agricultural industry leads inevitably to sterility and unproductiveness of the land itself—the nation's greatest and most valuable asset, next to its people. As Mr. Kendall truly says of the bad farmer who is living on his landlord's capital as well as his own, " when he goes out of business he may leave behind him a worn and wasted holding which becomes a national liability."

These " national liabilities " have been multiplying exceedingly through the land during the present century and have become a grave national menace.

Mr. R. J. Thompson : I should like to congratulate Mr. Kendall on his enterprise in attempting in Table I an estimate of the income and expenditure of British agriculture. On the income side of the account there is no difficulty but, as he points out, reliable information as to expenditure is very deficient. Perhaps as a result of this paper we may hope that after the war official statistics on the subject will be improved. In the meantime, Mr. Kendall's estimates are probably as accurate as circumstances permit, though I am somewhat doubtful of the item of £33 millions for rent and mortgage payments. This seems to me on the low side. It includes the rent paid to landlords in respect of two-thirds of the total area and the mortgage payments of the owner-occupiers of the remainder. These latter payments, however, are not on the same footing as rent, which includes the upkeep of buildings, fencing, etc., borne by the landlord. The deductions from the gross rent on this score are appreciable. For example, I was supplied a few years ago with

information relating to a large estate of 220,000 acres which showed that the outgoings were 49 per cent. of the gross rent on the average of the four years 1930–33, and 44 per cent. in the preceding four years. On some other estates the proportion was even higher. There seems to be no allowance in this table for corresponding outgoings on the part of the owner-occupier, and I am inclined to think it would be more correct to assume that all land carried the same average rent, whether it was paid to a landlord or retained by the owner-occupier to defray upkeep and to pay mortgage charges.

The balancing figure in the table is of interest, though its value is weakened by the impossibility of any great precision in the items which make up the total expenditure. It is evident, however, that there must have been in 1937–39 a not inconsiderable difference between receipts and outgoings in favour of the farmer; on the figures given this amounted to some 29 per cent. of the turnover and nearly 18 per cent. on the tenant's capital. If this was actually realized it would provide a not unreasonable return.

To make this balancing figure really valuable, however, an estimate on the lines of this table needs to be worked out annually so as to show the extent to which the " balance " varied from year to year. More precise statistics would be required before this could be done, but provided each item was estimated on a uniform basis a sufficient degree of relative accuracy ought to be obtainable to admit of comparison over a series of years. The balancing figure would then provide an indication of the fluctuations in agricultural prosperity which is not at present available from any other source. A small item in this table which should, I think, be deleted is the allowance for Income Tax and Schedule A. Tax in the case of owner-occupiers. The farmer is very lightly treated in the matter of income tax, but whatever is paid is not chargeable as part of the farm expenses, but is payable out of profits or income as with the rest of us.

One other point I may mention relates to long-term credit. Mr. Kendall assumes that some 50 per cent. of the land is mortgaged to an amount of about £250 millions. But surely a large part of this must consist of mortgages raised by landlords for purposes which have nothing to do with agriculture. The interest on such mortgages has to be met from the landlord's income, whether derived from rent or from other sources, and so long as the landlord fulfils his obligations to the tenant farmer as regards upkeep, etc., it does not seem that agriculture as such is affected.

As regards under-capitalization, I agree with Mr. Kendall that the real cure is the prevention of violent price changes. Tenant's capital is very largely in the form of live stock and crops, so that when a continuous fall in the price level occurs, as in 1930–34, a proportion of the capital is automatically wiped out, while at the same time the profit balance between receipts and outgoings is reduced. The result is necessarily under-capitalization, which it may take years to overcome. Of course, in years of rising prices, the farmer correspondingly benefits. Both conditions, though real enough in practice, are artificial in character, and tend to make

farming a somewhat speculative undertaking, which is not conducive to maximum production. What is needed is reasonable stability in the price level.

SIR WILLIAM DAMPIER : I have read Mr. Kendall's paper with much interest, and I have made a few notes from the point of view of a country landowner.

1. In Table III rent is put at an average of 20 per cent. of a farmer's receipts. I imagine this to mean the gross rent paid. But the author goes on : " labourers get about half the net income, and the remainder is divided equally between landlord and farmer." This might be understood (or misunderstood) to mean that the landowner gets a quarter of the total for himself. But from the gross rent paid by the farmer the owner has to provide for tithe redemption, repairs, insurance and management and, as shown in my address to the Agricultural Economics Society in 1930, these outgoings on the average amount to about half the gross rent. Thus the landowner gets only about one-eighth of the farm receipts for himself, and from this has to pay income tax, etc.

2. Table IV shows the percentage of farmers who are owner-occupiers in different countries. This alone does not give a good picture of the countries' agriculture. The situation would be made clearer if the author gave also the percentage of the total area of the land which was farmed by owner-occupiers. Again, in the footnote to p. 113, it is stated that, in the United Kingdom, 66 per cent. of the holdings are less than 50 acres : here also the acreage is important; much more than 34 per cent. of the area of the country is farmed in larger holdings.

3. Mr. Kendall is quite right to point out that the customary delay in paying rent means the provision of some short-term credit by the landowner in favour of his tenants. I think the average delay would work out at about two months. If so, and if the rent is reckoned at 24 per cent. of the total turnover, a farmer would get the equivalent of continuous credit for about 4 per cent. of his turnover from this source. This custom is part of the consideration shown between landlord and tenant in past (and even present) conditions. Whether landowners will find it financially possible in future, and whether the destruction of amenities will cease to make the provision of fixed capital on the land worth while, remains to be seen.

4. The footnote on p. 130 suggests that the present banks are less willing lenders than the old private banks. I have seen figures which go to show that present loans to farmers are more than of old, but I cannot give a reference.

5. Mr. Kendall holds that it is a good sign when an industry can finance itself out of debts (p. 128). As regards large-scale industry, I agree; but the small individual farmer would find it difficult to handle credit in this way.

6. On p. 131, Mr. Kendall discusses the impoverishment of the land where tenants hang on by living on their, or their landlord's, capital. I think it should be noted that this is partly due to successive Agricultural Holdings Acts, all framed in the interest of tenants. The Acts make it very difficult for a landowner to get rid of a bad, unsatisfactory tenant and recover his own property when harm is being done.

DR. C. S. ORWIN : I should like to thank Mr. Kendall for bringing together so many useful statistics about farm finance, and any remarks which I have to offer are more by way of comment than of criticism.

Mr. Kendall is fully alive to the difficulties of equating statistics for an industry so diverse in its manifestations and so variable in the organization for production displayed by its units. How can you bring together, for example, for comparative purposes the little milk producers of South Wales, milking perhaps a dozen cows and working entirely with family labour, and the captains of the dairying industry with herds running up to a thousand head in a few cases ? Probably close analyses can only be made by careful grouping of like and like, but given a sample large enough and some heading and tailing, certain generalizations may safely be made.

Otherwise, my comments on Mr. Kendall's paper refer only to details. The risks of farming are always being emphasized, but are they so great as Mr. Kendall suggests ? Weather, for example, must affect crop yields and quality, but to say that a few days' bad weather can wipe out a year's labour seems an over-statement. A farmer for sixty consecutive years on one holding told me that he had never known the year in which he could not have sown his corn and gathered his harvests if he had taken his chances.

Why is it that there is no joint-stock in British farming ? Mr. Kendall again attributes it to the risky nature of the business. Is farming more risky than gold-mining, or, to stick to the surface of the land, than rubber-growing or tea-planting ? I think it has still to be explained why large-scale farming has not developed in this country, and I regard the fact that it has not as the principal explanation of the slowness of farming to apply the lessons of science and the products of invention to increase productivity and to reduce costs. I find a suggestion of inevitability in Mr. Kendall's references to the small-scale organization of the British farming industry with which I am hardly in agreement, and I attribute a good deal of the farmers' difficulties to the small scale of their operations, which makes it impossible for them to pay for brains in management or mechanical skill in labour.

I confess to considerable surprise on reading Mr. Kendall's observations on long-term credit. Generalizing from the operations of the Agricultural Mortgage Corporation, he concludes that half the agricultural land of England is mortgaged, for an average of £13 10s. 8d. per acre, and I cannot follow him in this calculation. The Agricultural Mortgage Corporation was brought into being to meet a special situation rendering the provision of a new source

of long-term credit necessary. The break-up of large estates in the years 1919–22 transferred about 20 per cent. of the cultivated land of the country into the hands of owner-occupiers, mostly at inflated prices, and the Corporation was formed, with financial backing from the State, to enable this new class of landowner to substitute a long-term rent-charge for short-term bank loans against title-deeds or for private mortgages of uncertain duration. All the conditions were abnormal and the case had no relevance to traditional landowning experience. It is true, of course, that many old estates are burdened with a great variety of charges, for widows' jointures, marriage settlements, younger children, and to a much lesser extent, I am afraid, for capital improvements, but the statistics of the Agricultural Mortgage Corporation throw no light upon this position.

As to short-term credit, I agree that bank credit and merchant credit, the two old-established sources of supply, are sufficient for the needs of the industry. Merchant credit is really only bank credit in another guise, for the merchant is himself a borrower from the bank to meet his customers' needs, and he acts as an unofficial middleman for bank loans.

Mr. J. H. Kirk: Mr. Kendall's paper—which has brought together for the first time much valuable material too long left lying in a scattered form—seems to me to lead to several conclusions : in particular that ". . . at the present time the credit needs of agriculture, broadly speaking, are being met." I imagine that this conclusion may cause some surprise, but it seems to me to follow not only from Mr. Kendall's account of the facts but from a considera-tion of what we ought to mean by " credit shortage."

We can, to my mind, look on almost any farmer's balance sheet as consisting of a quantity of credit, which he has borrowed, pyra-mided on a quantity of his own capital. If the pyramid grows too tall by over-borrowing it becomes unstable, and will be overturned by crop failure or animal disease. There is thus a safety ratio of borrowing for each farmer, and it is to the interest of both the farmer and his creditors to see that this ratio is not exceeded. Thus to justify extra borrowing it is necessary first to broaden the base of the farmer's own capital, by securing to him an income out of which he can save, or to provide conditions of stability of income under which the safety ratio is itself increased.

During the war both these things have happened, and probably many farmers are now below their safety ratio- *i.e.* if they needed to do so, they could safely borrow more and lenders would be willing to lend. Even in peace-time, however, there was ample credit in the sense that the amount available was sufficient to finance every farmer up to the limit of his safety ratio. It would indeed be rather curious if, in a wealthy industrial country, there were not sufficient funds available to finance on a generous scale the fairly modest requirements of agriculture. What passes for credit shortage is, for the most part, really under-capitalization— a problem which is difficult enough without being misnamed or confused with credit shortage.

This problem of under-capitalization is, of course, the problem of the farmer whose own capital is so slender that he cannot build up a pyramid of farm assets large enough either to make the best use of his land or to earn a decent income. (Incidentally there is a sort of spiral effect— an insufficient income prevents any broadening of the base of the structure and may indeed cause it to contract.) Such a farmer is usually a man who has started off with insufficient capital, or whose insufficient skill or education, or bad luck, have lost him part of his original stake. Such a farmer is also likely to have started on or gravitated to a bad farm, under a bad landlord, where he has become more than ever stuck. This trouble cannot be overcome merely by permitting or tempting him to ignore his safety ratio, but, as Mr. Kendall has pointed out, the Agricultural Requisites Assistance Scheme is now available to deal with these cases along rather novel lines.

One last point. On p. 114 Mr. Kendall arrives at an estimate of farmers' labour income of £52 millions. If I follow his argument correctly, the figure should be £4–5 millions greater, since this amount has already been charged as mortgage interest before arriving at the figure of £82 millions from which the £52 millions is derived.

MR. KENDALL, in reply, wrote :—I am grateful to the contributors to the discussion for their kind remarks and the very useful comments which they have made. Except for some points of detail, which I refer to in a moment, we seem to be in general agreement, but I must clear myself of one charge brought by Lord Bledisloe. I am not in the least complacent about the position of agriculture. In fact, I think the problem of establishing it in a satisfactory position in the midst of an economy which must remain on an industrial basis is one of the greatest confronting our post-war statesmen. What I have said is that in my opinion the agricultural credit position at the present time is, broadly speaking, satisfactory ; and that the problem of under-capitalization and derelict farms is not one to be solved primarily by an extension of credit facilities. In terms of Mr. Kirk's useful concept of the financial pyramid, I think we must broaden the base before we try to increase the height.

With Mr. R. J. Thompson's observations I agree almost entirely. For some purposes it might have been better to allow in the rent figure for some of the comparable expenses of upkeep borne by owner-occupiers, which are at present merged in the miscellaneous item —it all depends on what one is trying to show. The same is true of the inclusion of the item for Income Tax and Schedule A. I also agree that of the interest on the estimated £250 million mortgage a good deal is borne out of non-agricultural sources of income. The difficulty is to know how much.

The only small difference of opinion between Sir William Dampier and myself concerns his fifth comment. I should still regard it as a healthy sign, even in a small farmer, if someone was prepared to lend him money, and as by no means a bad sign if he took advantage of the fact.

Dr. Orwin queries my explanation of the absence of joint-stock farming in agriculture, and I confess that it does not carry complete conviction.   But I cannot think of a better one.   As regards his comments on the long-term credit position, I think he does me an injustice in supposing that I regard the mortgages of the Agricultural Mortgage Corporation as fully representative.   I used their figures mainly to arrive at an estimate of the average amount of mortgage per acre, and I cannot see that the considerations advanced by Dr. Orwin invalidate the assumptions.

Mr. Kirk has made a characteristically helpful contribution by introducing the clarifying concept of the credit pyramid.   He is, of course, speaking of short-term credit only, and I am glad to see that his own conclusions support my own.

PROCEEDINGS OF THE FIRST ORDINARY MEETING OF THE SESSION 1940-41 HELD ON APRIL 15TH, 1941, THE PRESIDENT, MR. H. LEAK, IN THE CHAIR.

The PRESIDENT, opening the Proceedings, said :—

We have suffered a great loss by the death of our President, Mr. Macrosty, which occurred on January 19th. The Council of the Society, on which he had served for so many years, passed the following resolution :

" The Council of the Royal Statistical Society desire to place on record their sense of the irreparable loss they have sustained by the death of their old and valued colleague, Mr. Henry W. Macrosty. Elected a Fellow in 1904, he served on the Council from 1917 to 1920 and then from 1925 continuously, holding the office of Honorary Secretary from 1928 until his election to the Presidency in June 1940.

" After his retirement from the Board of Trade in 1930 Mr. Macrosty took a very active part in the work of the Society, always bent on preserving its honourable traditions while investing them with new life. In connexion with the centenary of the Society in 1934 he placed all the Fellows under a debt of gratitude by producing an attractive volume embodying the history of the Society since its origin. His many contributions to the *Journal* substantially helped to maintain the high standard which had been built up during the century of the Society's existence, and their merits received especial recognition in the award of the Guy Medal in silver in 1927.

" His death will be deeply felt by his Colleagues and by the many Fellows who knew him as a Friend. On behalf of the Society the Council desire to record their heartfelt sympathy with Mrs. Macrosty and her daughter and granddaughters in their bereavement."

To that resolution I must add a few words. Of Macrosty's work in and for the Society there is no need for me to speak—it is summarized in the resolution and is well known to you all. He has done much for us, and he was so youthful in spirit and so enthusiastic and energetic that, despite his 75 years, we had hoped and expected that he would be among us for a long time to come. We mourn his loss not only, nor perhaps even primarily, as a statistician and economist, but as a man of courage and goodwill—one whose contribution to life was of inestimable value in these present days. His was a very kindly disposition, and he formed a great circle of friends among the Fellows of the Society. There must be few who attended our meetings to whom he was not known personally, and

his death will be widely felt. He attained a great ambition of his life when he was elected President, and every one will regret that he was taken from us before he was able to occupy the Presidential chair at an Ordinary Meeting of the Society.

Macrosty was an honoured member of the staff of the Board of Trade for 24 years, and he has described in his delightful Presidential address, which was published in the first part of this year's *Journal*, the career of what in 1884 when he entered the Civil Service was described as a "Man Clerk of the Lower Division." In the Board of Trade, as in the Society, he was well known to every one and made friends among all classes, the highest and lowest alike. His work there in connection with the Census of Production and during the last war with shipping brought him into contact with industrialists and shipowners, among whom he formed many permanent friendships. He made a practice of calling to see me at the Board of Trade each month before the meetings of the Executive Committee, and I looked forward to discussing with him some of the problems arising in connection with the work of the Statistics Department. His wise comments were invaluable.

The maintenance of a close link between his two statistical interests—the Society and the Board of Trade—was very dear to Macrosty, and it is gratifying to me to feel that, in filling for a time the place which his death left empty, I am helping to continue the tradition which he for so long upheld.

The association between the Society and the Board of Trade has always been a close one. Several of the original founders were connected with that Department, and no less than ten out of the sixty Presidents have either spent their careers in the Board of Trade or represented it in Parliament. The Parliamentary connection mostly comes first— as Mr. Macrosty mentioned in his Presidential address, the list of names of our early Presidents reads like a page of Debrett. Viscount Sandon, later Earl of Harrowby, one of the original members of the Council, became President of the Society in 1840, having been Vice-President of the Board of Trade for 11 years, from 1790 to 1801. Mr. Gladstone, appointed President of the Board of Trade in 1843, joined the Society in 1834, the year of its formation, and became our President in 1867; it was during his tenure of that Office that he first became Prime Minister. Mr. G. J. Shaw-Lefevre, later Lord Eversley, and Mr. Goschen, later Viscount Goschen, were elected Presidents in 1877 and 1886, having previously been respectively Parliamentary Secretary and Vice-President of the Board of Trade. It may be recalled that the latter office was abolished in 1867 and a Secretary with a seat in Parliament substituted. Lord Eversley's father, Sir J. G. Shaw-Lefevre,

was also connected with the Society and the Department, being one of the original members of the Council in 1834 and Joint Secretary of the Board of Trade seven years later. Prior to Lord Goschen's presidency, we had as President the first of the permanent officials of the Board of Trade to hold that office, Sir Robert Giffen being elected in 1882 while he was in charge of the Commercial and Statistical Department. Lord Farrer, Permanent Secretary of the Board of Trade for over 20 years, became our President in 1894, eight years after his retirement from the Public Service. Sir Alfred Bateman, who succeeded Sir Robert Giffen in 1897 as Comptroller General of the Commercial, Labour and Statistical Department of the Board of Trade—you will note the enlargement of its function during Sir Robert Giffen's tenure of office—was appointed President of the Society six months previously on the death of the existing President. This was the first time a President had been appointed by the Council under byelaw 15. My appointment is the second, and it is a curious coincidence that the Council on each occasion should have selected from among the Vice-Presidents someone connected with the Board of Trade. The next President connected with the Board of Trade was my immediate predecessor, Sir Alfred Flux, elected in 1928. He was the first Assistant Secretary in charge of a separate Statistics Department in the Board of Trade since 1880. As many of you know, he went to live in Denmark when he retired, and those who knew him will be glad to hear that, in a letter written last November but only received recently, he writes quite cheerfully and says he is enjoying good health. And so we come to Mr. Macrosty. He and Flux were inseparable companions. They spent practically the whole of their official careers in the Board of Trade together, and in other spheres of interest there was a close collaboration between them which lasted up to Macrosty's death.

Those present to-day will wish to honour his memory, and I ask you to stand for a moment as a token of respect.

The audience stood in silence for a few moments.

Professor Major Greenwood was then called upon to read the paper which follows.

Deaths by Violence, 1837–1937

By M. Greenwood, W. J. Martin and W. T. Russell

In these days when death in battle is an event too frequent to excite comment, there is some interest in studying the history of mortality due to violence not generated by herd passions. Indeed, such an enquiry, like a detective story, has merit as " escape literature." We are not, indeed, transported to a country house, in the improbable library of which the corpse of an incredibly unpleasant murder is lying, while the 14 bedrooms are occupied by 13 guests with motives and 1 detective. The 22,796 persons who died violent deaths in England and Wales in 1937, or the 11,968 who died in 1840, were not fictions, but flesh and blood, and the manner of many of the deaths was more horrible than the blunt instrument of our country house. Yet it *is* a wholly different atmosphere from that of high-explosive bombs or torpedoes.

One is apt to guess that in long-past times death by violence was a much more usual path to Avernus than in the twentieth century. Perhaps it was, when total warfare was the normal state of existence and (see *3rd A.R.*, pp. 86–88) in the seventeenth and eighteenth centuries the chance that a Londoner would be murdered, hanged or " killed " was much greater than in the nineteenth century. But in the seventeenth century not quite 1 per cent. of all deaths were due to violence, while in 1938 of 46,456 deaths in the County of London 2,106 or 4·5 per cent. were so designated. The reason is, of course, that in the past " natural " deaths were relatively more frequent and death-dealing machinery not yet invented.

A precise comparison of rates of mortality over the century of registration is impossible because of changes in classification, the general effect of which has been to diminish the recorded rate. The first alteration of causes that constituted violent deaths was made in 1861, when deaths from intemperance, privation of food and want of breast-milk were no longer classified as due to violence. In 1901 the number of causes of violent deaths was reduced by the transfer to general diseases of deaths from food poisoning, ptomaine poisoning, industrial poisoning, injury at birth, navel hæmorrhage, opium and morphia habit. Deaths following a slight injury, from tetanus, erysipelas, pyæmia, septicæmia, were also no longer considered as violent deaths. Starvation and food poisoning were added to the causes of violent deaths in 1911, but chronic lead

poisoning (non occupational), amputations, lack of care at birth, and deaths connected with anæsthetics were transferred from the list of violent deaths. Lack of care at birth was transferred from diseases of early infancy to violence in 1931. The death rates shown in this paper were obtained by using the 1931 classification from 1911 to 1938 and the 1911 classification from 1891 to 1911. For 1911, when it is possible to use both classifications, the 1931 grouping gives an increase of 0·6 per cent. over that of the 1911 grouping. If the pre-1901 classification is used the mortality from violence would show an increase of 3 per cent. in 1891 and 5 per cent. in 1900 on the value found by the 1911 classification.

The death rates for the periods when the trend was steadily changing, 1878–89, 1899–1910 (decreasing rates) and 1922–30 (increasing rate) have been divided into components. Although for the first two periods the average annual decrease in the death rate was the same, the various causes showed considerable variation. During the first two periods the annual rate for suicide showed an increase in contrast with most of the other causes; the average annual rate of increase being twice as large during 1899–1910 as during 1878–89.

TABLE 1

Standardized Rates per million

Period	Suicide		Other violence		All violence	
	Males	Females	Males	Females	Males	Females
1861–70	105	35	1,064	314	1,169	349
1871–80	115	36	993	304	1,108	340
1881–90	128	39	829	284	957	323
1891–00	144	44	790	313	934	357
1901–10	157	47	670	282	827	329
1911–20	119	43	729	255	848	298
1921–25	129	46	479	172	608	218
1926–30	146	57	542	201	686	258
1931–35	152	62	496	198	648	260

Suicide accounted for roughly one-quarter of the average increase in the death rate during 1922–30, but the increase in road accidents was mainly responsible for the trend of the death rate for violence. These deaths are shown in detail in the lower part of the table. With the exception of electric tramcar, motor-cab and char-a-banc, with a constant death rate, the other groups of vehicles showed an increase. The death rate from accident caused by motor omnibus in 1930 was four times that of 1922, whilst the rate for motor cycles had increased six-fold.

TABLE 2

1878–1889. Death rate from violence per million

	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	Regression coefficients	
													a	b
Suicide	70	80	77	75	75	74	76	74	82	80	82	76	+0·49	+0·64
Accidents, coal-mines	40	41	42	33	39	34	30	34	31	30	26	30	−1·25	−3·66
Accidents, railways	44	39	42	42	39	38	36	30	29	28	27	30	−1·59	−4·50
Accidents, road transport	59	53	51	55	55	53	58	55	53	55	53	54	−0·11	−0·20
Accidental drowning	146	111	117	114	109	104	97	90	102	96	85	90	−3·92	−3·73
Other violence	394	371	350	378	355	376	359	351	337	363	349	334	−3·49	−0·97
All violence	753	695	679	697	672	679	656	634	634	652	622	614	−9·88	−1·48

a. Regression coefficients of observed rates.
b. Regression coefficients of rates expressed as percentages of mean rate.

TABLE 3

1899–1910. *Death rate from violence per million*

	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	Regression coefficient—	
													a	*b*
Suicide	89	90	96	99	105	99	104	101	102	108	101	100	+1·09	+1·10
Accidents, coal-mines ...	24	25	27	24	25	25	28	27	27	29	34	31	+0·68	+2·50
Accidents, railways ...	32	31	28	28	26	24	25	26	25	22	20	21	−0·97	−3·78
Accidents, road transport ...	57	55	54	49	48	49	46	47	49	49	44	46	−0·91	−2·12
Accidental drowning ...	89	82	85	69	76	72	74	68	65	70	62	63	−2·14	−2·93
Other violence	361	341	346	320	300	308	295	301	297	296	279	262	−7·42	−2·40
All violence	652	624	636	589	580	577	572	570	565	574	540	523	−9·66	−1·66

a. Regression coefficients of observed rates.
b. Regression coefficients of rates expressed as percentages of mean rate.

TABLE 4

1922–1930.   Death rate from violence per million

	1922	1923	1924	1925	1926	1927	1928	1929	1930	Regression coefficients	
										a	b
Suicide ...	102	103	96	105	114	125	124	126	127	+ 4·08	+ 3·59
Accidents, coal-mines	23	27	27	26	16	25	22	24	23	− 0·33	1·39
Accidents, railways	13	13	15	14	11	12	13	12	11	− 0·28	− 2·21
Accidents, road transport	72	79	93	102	119	125	147	159	177	+13·18	+11·06
Accidental drowning	40	44	40	42	39	40	41	38	36	− 0·57	1·43
Other violence	184	184	178	186	183	190	197	197	187	+ 1·55	0·83
All violence ...	434	450	449	475	482	517	544	556	561	+17·63	+ 3·53
Motor-car ...	20	22	26	25	30	33	39	42	41	2·97	9·62
Motor-van, lorry, etc.	14	15	17	21	22	24	24	29	32	2·18	9·91
Electric tramcar	2·0	2·1	2·1	2·4	2·4	2·1	2·6	2·2	1·8	0·003	0·14
Motor-cab ...	1·3	1·3	1·5	1·4	1·3	1·2	1·7	1·4	1·3	0·008	0·58
Motor omnibus	4·4	5·7	8·2	9·8	10·1	10·9	14·1	14·7	17·4	1·53	14·45
Motor char-a-banc, etc.	0·6	1·1	1·4	1·6	1·2	1·1	1·2	1·3	2·5	0·12	9·00
Motor cycle ...	5·6	7·7	9·4	14·0	20·0	23·9	26·4	29·3	32·3	3·59	19·17
Others ...	7·3	9·5	12·9	12·6	17·6	17·8	23·9	26·1	32·3	2·95	13·28
All mechanically propelled vehicles (not railways) ...	55	64	78	88	104	114	133	146	161	13·43	12·83

a. Regression coefficients of observed rates.
b. Regression coefficients of rates expressed as percentages of mean rate.

The ratio of male deaths to female deaths declined throughout the three periods. The ratios were :—

TABLE 4A

Period	Male/Female	Period	Male/Female	Period	Male/Female
1878–80	2·72	1899–01	2·36	1922–24	2·30
1881–83	2·75	1902–04	2·36	1925–27	2·24
1884–86	2·68	1905–07	2·33	1928–30	2·21
1887–89	2·51	1908–10	2·29		

Taking the figures as they stand (graph), it may be said that from 1837 to 1878 the death rate from all forms of violence oscillated violently, but displayed no secular trend. In the next ten years there was a decline, then a period of stasis for ten years, followed by a decline until 1922, since when the movement has been upwards. But (Table I) the standardized rates of 1931–35 are considerably less than those of 1861–70. For males 55·4 per cent. and females 74·4 per cent., although the proportional mortality is higher; natural mortality has declined at a faster rate than unnatural mortality.

Although the Registrar-General tabulates deaths from violence with great precision, it is less easy than might be surmised to draw useful conclusions from the data. We may illustrate the difficulties on a simple example. Between 1881–85 and 1934–38, the death rate of males from drowning not classed to suicide fell to one-third— from 174 to 54 per million. In the first place, does this mean precisely what it says, viz. that the proportion of males living who died of *drowning* decreased in the stated ratio? It almost certainly does not. Of the rate 174 per million, one item is 67 " Found Drowned," of the 54 per million 23 were " Found Drowned."

Virtually all diagnoses of the causes of violent deaths rest upon the finding of a Coroner's inquest, which in the past was always the verdict of a jury. " Open " verdicts have decreased in frequency, notably that of " Found Drowned," and it is not unreasonable to think that " Suicide while Temporarily Insane " has absorbed some of the " Found Drowned," under the more searching scrutiny of modern inquisitions. However, if we omit this item altogether, the relative reduction is not affected; the 1934–38 rate is, indeed, less than one-third of the 1881–85 rate. There remains the question whether the decline is due to (*a*) decrease of risks or (*b*) greater security against unchanged risks, or, of course, a combination of the two. If fewer people ventured themselves on water, or if more did so but had better ships, or could swim better, the rate of mortality from drowning would decline. It is not part of the Registrar-General's original duty to answer such questions. Rates of mor-

tality are ratios of deaths to population, and in many national rates of mortality the numerator and denominator are heterogeneous. Only those in coal-mines are exposed to the risk of dying in mine explosions, and persons who have never had syphilis—fortunately a large proportion—are at no risk of dying of general paralysis of the insane or *Tabes dorsalis*. That is no reason why general rates of mortality should not be stated. Indeed, it might fairly be urged that to refrain, as has been the practice since 1921, from giving rates of mortality on persons for diseases peculiar to women (or men) is illogical. Certainly no male can possibly die of cancer of the uterus, but that is only an extreme instance of lack of congruence between numerator and denominator. Rates of mortality on persons are simply indices of death tolls; why these have risen or fallen must be ascertained by further analysis. Actually the General Register Office has, since its foundation, supplied data for making further investigation, but these have been less complete with respect to deaths from violence than for deaths from disease. One reason is that those human institutions which, in the past, were the principal sources of violent deaths—viz. factories, mines, railways and ships—have long been objects of statistical attention in government offices other than the General Register Office. It follows that a paper confined as this is to data published in the Annual Reports of the Registrar-General can only give a very summary and incomplete interpretation of changes. One may point to the fertility or barrenness of a fig tree without complete botanical knowledge of the reasons.

Accidents and Negligence

Deaths from accident or negligence were first tabulated in detail in the report of 1881. Changes in classification and tabulation prevent an examination of the trend of the various causes of fatal accidents over an extended period, but an attempt has been made, in broad groups, to present the main causes of fatal accidents for the last three-quarters of a century, and the results are shown in Table 5.

In the Registrar-General's report of 1868, pages 201–13, Farr discusses the causes of accidental death and the question of compensation. Regarding the persons killed in London streets he states, " They have attained an extraordinary magnitude in recent years," and later says, " Negligence and unskilful driving by a vanman is as often as fatal as furious and skilful driving by a cabman." The rapid increase in fatal accidents following the use of mechanical power illustrates his remark, " Still mechanical force, steam and chemical agency are undoubtedly new elements of danger

to mankind." The deaths, one male and one female, registered in 1896 marked the beginning of the toll of accidents due to motorcars, the first deaths registered from motor-cycle accidents were those of two males in 1902.

The break in the method of presenting statistics of violence has not affected childhood so much as later life, since the causes of death are not so numerous. An attempt has been made to present the rates for two age groups, under one year of age and

TABLE 5

Death rate per million

	1863–70	1871–80	1881–90	1891–00	1901–10	1911–20	1921–30	1931–38
Males								
Mines, quarries								
Coal-mines ...	96	81	66	57	57	68	48	40
Other mines ...	13	8	4	9	9	6	4	3
Vehicles, etc.								
Railways	71	89	62	59	47	45	24	20
Horse vehicles and horses	124	107	94	86	59	44	13	5
Other vehicles ...	—	—	1	4	22	75	170	235
Drowning	214	207	166	151	121	120	70	58
Burns, scalds, etc.	109	90	74	73	64	58	38	29
Suffocation (all forms)	73	76	77	81	63	44	23	20
Females								
Vehicles, etc.								
Railways	5	6	5	4	3	3	2	2
Horse vehicles and horses	19	17	16	16	11	9	2	1
Other vehicles ...	—	—	0·3	1	6	21	51	75
Drowning	37	41	31	27	22	22	15	12
Burns, scalds, etc.	112	92	73	87	83	71	44	38
Suffocation (all forms)	47	56	61	66	51	30	16	11

1–5 years, for all accidents and for the principal sub-headings; the results are shown in Table 6. The fall in the death rate amongst infants was due to the decrease in the number of deaths from suffocation; suffocation occurred mainly in bed, cot, etc. Deaths from burns and scalds among babies have not shown any improvement. In his report for 1890, page XVI, the Registrar-General examined the infant deaths from suffocation. One-fifth of the deaths under one year occurred in the first month of life. There was a seasonal trend—60 per cent. of the deaths occurring in the winter

six months.   Deaths from overlaying were twice as numerous on Saturday night as any other night.   He concluded that the real cause was the drunkenness of the parents.   Whether this is wholly correct may be doubted.   Brend * has given quite cogent reasons for holding that many of these deaths were really due to pneumonia.

TABLE 6

Accidents and negligence

Death rate per million at ages under one year

Period	Males			Females		
	Burns and scalds	Suffoca-tion	Total	Burns and scalds	Suffoca-tion	Total
1863–70	147	1228	1731	150	1179	1645
1871–80	138	1429	1867	127	1469	1805
1881–90	128	1690	2020	120	1693	1994
1891–00	131	2128	2524	130	2069	2393
1901–10	148	1827	2340	144	1782	2253
1911–20	150	1231	1539	121	1172	1435
1921–30	147	658	886	116	592	772
1931–38	138	590	824	106	468	633

Death rate per million, ages 1–5 years

Period	Males					Females				
	Falls	Burns and scalds	Drown-ing	Vehi-cles	Total	Falls	Burns and scalds	Drown-ing	Vehi-cles	Total
1863–70	63	629	217	104	1129	39	495	95	72	781
1871–80	62	476	207	99	951	41	378	96	66	659
1881–90	78	400	148	98	821	51	297	72	64	552
1891–00	69	448	126	95	848	48	390	58	65	634
1901–10	65	435	107	86	778	44	406	48	60	612
1911–20	49	374	109	103	705	29	348	39	64	536
1921–30	32	311	77	157	628	20	228	29	93	401
1931–38	31	206	64	180	524	23	152	24	106	331

The rate for the three groups, falls, burns and scalds, and drowning has been halved for the toddlers of 1–5 years, but the death rate for vehicles has been practically doubled in the past three-quarters of a century.

Suicide

Suicide has been a favourite topic for sociological and statistical disquisition.   The recorded rate increased between 1861–70 and 1931-35 by 96 per cent. in males and more than 100 per cent. in

* Brend, W. A. *Enquiry into the Statistics of deaths from violence and unnatural causes in the United Kingdom.* London, 1915, *pp.* 49 *et seq.*

TABLE 7

Suicide. Mean annual death rate per million

Period	Males										Females									
	10–	15–	20–	25–	35–	45–	55–	65–	75–	All	10–	15–	20–	25–	35–	45–	55–	65–	75–	All
1861–70	4	28	59	93	163	263	377	359	251	100	3	31	31	35	53	84	87	83	70	34
1871–80	4	24	64	104	179	276	408	416	335	107	3	26	33	39	54	81	95	92	64	35
1881–90	4	29	67	117	202	310	437	478	373	118	3	34	40	43	64	84	92	86	53	37
1891–00	5	34	84	142	241	348	456	479	386	137	4	37	41	52	76	96	100	88	52	44
1901–10	4	36	91	152	252	397	523	508	382	158	3	34	45	56	80	109	109	88	49	49
1911–20	3	32	69	122	196	278	389	380	350	130	2	30	41	50	74	100	102	81	52	47
1921–30	2	32	79	109	210	350	479	504	429	166	0·8	25	43	57	87	135	140	106	62	63
1931–35	2	39	96	141	209	379	542	534	483	196	0·5	23	49	77	108	153	165	135	84	80
1936–38	2	30	83	125	183	302	482	491	458	177	0·6	16	41	67	101	160	166	140	83	80

females. Age standardization diminishes the increase to 45 per cent. in males and 77 per cent. in females, and classification has its part in the increase, but when allowances are made for these factors, a large increase in the twentieth century persists. Classification difficulties are due, *inter alia*, to the decreasing rate of open verdicts and verdicts of "Found Drowned." The former decreased from 36 per million in 1916–20 (they are not tabulated for earlier years)

TABLE 8

Suicide 1930–32

Deaths per million in social class aggregates

Social class	Ages									Stan-dard-ized rate (ages 16 +)
	16–	20–	25–	35–	45–	55–	65–	70–	75 +	
All males ...	38	98	133	221	393	548	566	521	474	270
I	72	77	177	252	527	597	560	496	343	310
II	100	147	192	289	562	708	660	564	485	361
III	33	84	131	205	363	538	586	573	522	262
IV	47	112	117	199	319	468	516	459	546	241
V	34	102	111	202	334	470	537	578	568	246
Unoccupied ...	36	140	242	456	426	559	267	149	173	317
Married women	32	38	65	88	128	149	122	118	64	88
I	0	67	78	93	182	193	122	57	0	103
II	0	29	72	98	132	165	132	100	38	89
III	65	43	66	90	128	144	132	163	93	94
IV	0	29	49	75	109	120	126	103	26	70
V	0	27	62	75	113	154	87	76	107	77
Unoccupied ...	0	902	700	439	451	206	94	55	35	444
Single women...	28	49	87	124	179	197	146	134	90	117
I	0	0	0	268	222	0	0	0	0	86
II	48	71	65	128	139	103	120	160	55	98
III	31	42	87	128	169	201	175	159	72	117
IV	12	52	59	106	313	174	93	0	0	117
V	43	50	103	47	260	175	158	0	0	112
Unoccupied ...	23	66	106	121	185	234	139	129	103	127

to 26 per million in 1936–38. Verdicts of "Found Drowned" fell from 39 per million in 1863–70 to 15 per million in 1936–38. But even if all deaths so assigned were due to suicide—an improbable, indeed impossible, supposition—the proportional changes would still leave a heavy balance against the years after 1920. Children and adolescents have not shown any regular increase; indeed, the rate for girls of 15–20 has tended to fall. At older ages the increases have been striking; there is a difference between the sexes. The rate for middle-aged women has increased much faster than for men of like age.

At the date this paper has been written the decennium 1931–40 is not closed, and it is not just to compare a triennium with a decennium; if one takes the 8 years 1931–38, it will be noted that

TABLE 9

Suicide.   Crude rate per million

Period	Method of suicide									
	Poison	Hang-ing	Drown-ing	Fire-arms	Cut-ting and pierc-ing	Jump-ing from a height	Rail-ways	Coal gas	Other forms	All methods
Males										
1863–70	7·2	43·3	13·8	6·4	20·9	1·7	1·5	—	5·6	100
1871–80	8·4	42·7	17·7	7·2	22·6	2·0	2·6	—	3·5	107
1881–90	11·7	41·1	21·2	11·0	23·0	2·3	3·7	—	4·6	118
1891–00	17·6	40·9	25·2	15·0	25·8	2·7	5·4	0·1	4·4	137
1901–10	19·8	45·5	29·7	14·7	29·2	3·3	7·9	2·4	5·5	158
1911–20	11·2	34·7	24·1	13·4	29·8	3·2	6·9	5·1	2·0	130
1921–30	16·2	35·0	29·6	12·1	30·5	4·4	8·5	29·0	1·1	166
1931–35	21·0	34·0	29·0	12·7	25·6	5·5	10·0	55·9	1·8	196
1936–38	15·5	33·1	24·7	11·9	19·4	5·4	6·3	55·7	4·7	177
Females										
1863–70	5·7	10·1	9·6	0·1	5·5	1·2	0·2	—	1·5	34
1871–80	6·0	9·3	11·5	0·1	5·1	1·2	0·3	—	1·2	35
1881–90	7·6	9·1	12·6	0·2	4·9	1·4	0·4	—	1·2	37
1891–00	12·0	8·3	14·2	0·4	5·0	1·6	0·8	0·04	1·3	44
1901–10	12·7	8·7	15·9	0·4	5·3	1·8	1·1	0·8	1·7	49
1911–20	8·5	8·4	16·7	0·6	5·7	2·0	1·4	3·1	0·9	47
1921–30	12·2	7·4	16·4	0·6	5·2	2·7	1·3	15·4	1·5	63
1931–35	15·6	7·2	14·7	0·4	4·1	3·1	1·8	30·0	2·8	80
1936–38	12·7	7·7	14·2	0·4	3·4	3·4	1·9	33·7	2·5	80
Ratio of male to female rate										
1863–70	1·3	4·3	1·4	58·2	3·8	1·4	6·7	—	3·7	2·9
1871–80	1·4	4·6	1·5	90·0	4·4	1·7	9·6	—	2·8	3·1
1881–90	1·5	4·5	1·7	52·4	4·7	1·6	8·6	—	3·8	3·2
1891–00	1·5	4·9	1·8	38·5	5·2	1·7	7·2	2·3	3·4	3·1
1901–10	1·6	5·1	1·9	36·8	5·5	1·8	6·9	3·0	3·2	3·2
1911–20	1·3	4·1	1·4	23·5	5·2	1·6	4·9	1·6	2·2	2·8
1921–30	1·3	4·7	1·8	22·0	5·9	1·6	6·4	1·9	0·7	2·6
1931–35	1·3	4·7	2·0	28·9	6·2	1·8	5·5	1·9	0·6	2·5
1936–38	1·2	4·3	1·7	27·0	5·7	1·6	3·3	1·7	1·9	2·2

The ratio of male to female death rates for the two causes "firearms" and "railways" were obtained from rates with more figures than are shown in the top of the table.

in males for ages under 65 the decennium 1901–10 had a rate which seems a high-water mark. Since then the suicide rate has not increased. For women the case is different; at ages over 25 the most recent rates are much greater than those of 1901–10.

Much attention has been given to the social and regional distribution of suicide rates. In the social aggregates one has the following results, that the death rate tends to fall with social class for males and married women, but not for single women. The different trend exhibited by single women is due, probably, to the fact that in the first two social classes, one occupation accounts

TABLE 9A

1930–32	Ages 20–65		
	Registered deaths	Calculated standard deaths	Registered per 100 standard
(a)			
Judges, Barristers, Solicitors, etc. ...	35	16	219
Dental Practitioners	16	9	178
Defence. Commissioned Officers (active and retired)	41	24	171
Authors, Editors, Journalists	13	11	118
Physicians and Surgeons	25	23	109
Professional Engineers	26	30	87
Bank and Insurance Officials	30	36	83
Teachers (not music)	50	66	76
Civil Service and Local Authority (administrative and executive)	25	33	76
Clergymen, Ministers and Priests ...	22	31	71
Total	283	279	101
(b)			
Barmen	21	15	140
Costermongers and Newspaper-sellers ...	67	54	124
Dock Labourers	90	82	110
General Labourers and other Unskilled Workers	853	862	99
Builders', etc., Labourers	21	22	95
Messengers and Porters	59	64	92
Agricultural and Gardeners' Labourers ...	275	328	84
Railway Porters	41	52	79
Navvies in Building, etc.	49	137	36
Total	1,536	1,616	95

for half the population, Nuns in social class I and teachers (not music) in social class II (male teachers also have a low suicide rate). No reliable conclusions can be drawn from the high mortalities of the unoccupied group of males and single women, since the previous occupation is often unstated. There is, probably, better agreement between the occupation given in the census schedule and that given in the death certificate of married women than in the other two groups, since the husband would usually be

TABLE 10

Number of deaths from each method of suicide per 1,000 deaths from all methods

Period		Poison	Hanging	Drowning	Firearms	Cutting and piercing	Jumping from a height	Railways	Coal gas	Other forms	All methods
1863–70	Male ...	72	432	137	64	208	17	15	—	56	1000
	Female	168	296	283	3	162	35	7	—	46	1000
1871–80	Male ...	79	400	166	68	212	19	24	—	33	1000
	Female	172	268	333	2	148	34	8	—	34	1000
1881–90	Male ...	98	347	179	93	194	19	31	—	39	1000
	Female	202	243	337	6	131	37	12	—	32	1000
1891–00	Male ...	128	298	184	109	188	20	39	1	32	1000
	Female	274	191	325	9	116	37	17	1	30	1000
1901–10	Male ...	125	288	188	93	185	21	50	15	35	1000
	Female	261	183	327	8	109	36	24	16	35	1000
1911–20	Male ...	86	264	185	103	229	25	53	40	15	1000
	Female	179	178	354	12	121	42	30	65	19	1000
1921–30	Male ...	97	211	178	73	184	26	51	174	6	1000
	Female	195	118	262	9	83	42	21	246	24	1000
1931–35	Male ...	107	174	148	65	131	28	51	286	9	1000
	Female	196	91	184	5	51	39	23	376	35	1000
1936–38	Male ...	88	187	140	68	110	30	36	315	27	1000
	Female	159	96	178	5	42	43	24	422	31	1000

the informant of his wife's death and would give the same description of his occupation each time. This makes it difficult to offer an adequate explanation of the high rates experienced by the wives of the unoccupied males. Numerically this class is very small, and comprises only $\frac{1}{160}$ of the married women. Discussing the general mortality rates of these women, the Registrar-General stated, " They may well reflect the hardships to which these women are often necessarily subjected. The low rate of marriage and high rates of mortality of the unoccupied men themselves and the wives of those who are married are all consistent with the view that the absence of occupation was in the main due to physical or mental incapacity, and only in a small minority to the possession of independent means."

In a general way it seems that suicide is relatively more frequent among the black-coated classes. So long ago as 1880 the Registrar-General said that suicide was commoner among educated than uneducated people, and supported the statement with a table showing that the suicide in counties varied inversely as the proportion of persons unable to sign the register; it was 80·3 per million in counties with less than 17 per cent. unable to sign, but only 57·5 where as many as 27 per cent. were unable to sign. Comparing the suicide rates of males in specified occupations as given for the evaluation of 1930–32, one has a little evidence tending in the same direction.

It may be said that the quantitative differences are not impressive, but they are reasonably consistent from decade to decade.

We resist, without difficulty, the temptation to indulge in psychological speculations explanatory of this social differentiation.

In Table 10 one has a classification of the methods of self-destruction. Much the most striking feature of this is the increasing preference for the gas oven. In 1936–38 31·5 per cent. of all male suicides and 42·2 per cent. of all female suicides made use of coal gas. This convenient and well-advertised method of destruction was not readily accessible before the turn of the century, and only became popular after the last war. The following statistical experiment illustrates its importance. We took the standardized rates for women (the rates were standardized by finding a standardizing factor at each census year and applying it for the following decade), and fitted the curve $y = ·0055x + 3·519$ to the rates of 1860–90. We then used this to extrapolate rates for later years. Table 11 gives the extrapolates, the actual rates, the actual rates less those for coal-gas poisoning. We do not infer from this result that if (a) the modern gas oven had not been introduced, (b) newspapers reported suicides with that reticence imposed upon them

when divorce not from life but *a mensa et toro* is in question, the rate of suicide on women would not have increased. But we do suggest that the conveniences of modern life are factors of as much importance as the stresses and strains of modern life.

TABLE 11

Suicide. Females

	Standardized death rate per million (all methods of suicide)	Extrapolated values of $y = ·0055 x + 3·519$ (fitted to the rates of 1860–90)	Standardized death rate per million (omitting suicide by coal gas)
1901	46	42·3	46
1902	45	42·6	45
1903	49	42·8	49
1904	45	43·0	45
1905	47	43·3	47
1906	43	43·5	42
1907	48	43·7	47
1908	49	44·0	48
1909	47	44·2	45
1910	46	44·5	44
1911	46	44·7	46
1912	44	45·0	43
1913	45	45·2	43
1914	44	45·5	43
1915	44	45·7	42
1916	38	46·0	36
1917	35	46·2	31
1918	43	46·4	40
1919	45	46·8	43
1920	44	47·0	42
1921	43	47·3	36
1922	45	47·5	37
1923	45	47·8	34
1924	45	48·1	37
1925	50	48·3	38
1926	55	48·6	41
1927	57	48·9	45
1928	57	49·1	43
1929	58	49·4	42
1930	58	49·7	41
1931	58	49·9	37
1932	62	50·2	39
1933	65	50·5	41
1934	63	50·8	38
1935	61	51·1	37
1936	57	51·3	35
1937	60	51·6	37
1938	60	51·9	36

Is it possible to forecast from the available data the future of suicide rates? The answer is certainly "No." An application of logistics to the rates for females at ages over 45 *suggests* that increases will be slow, but does no more than suggest this.

No plausible extrapolation of rates for males has been found; as we have already pointed out, except at the oldest ages these rates are not increasing.

What effect the present resort to mass terrorism may have upon current rates of suicide is a question which our successors will answer. Statistically speaking, the last war considerably reduced the suicide rate for males and slightly reduced that for females. The male population at risk, within the ambit of the civil statistics, was so different from that of peace times that it permits no inferences. The female population was much less affected. But in the last war, although the *desire* of the barbarians to inflict mental suffering was no less than in 1940, their *powers* to do so were less.

TABLE 12

Homicides. Rate per million

Period	Murder and infanticide		Manslaughter		Execution	
	Males	Females	Males	Females	Males	Females
1863–70	12·5	11·1	12·0	3·9	1·09	0·068
1871–80	8·5	8·2	9·6	4·2	1·21	0·072
1881–90	6·3	6·7	8·0	3·5	1·06	0·042
1891–00	4·9	6·1	5·8	3·1	0·90	0·038
1901–10	4·7	5·9	4·1	2·9	0·96	0·023
1911–20	4·0	5·5	3·4	2·1	0·72	0
1921–30	3·2	4·6	2·7	1·2	0·64	0·010
1931–35	2·1	3·7	2·3	1·4	0·39	0·010
1936–38	2·0	3·3	2·1	1·1	0·37	0·031

Homicide, it will be seen (Table 12), has had a fairly steadily decreasing rate, and the comparison with the days of our grandparents is a reasonable source of satisfaction.

If one considers the data as a whole what should be the conclusion? Nearly 70 years ago Farr wrote : " The analysis of the causes of mortality renders it still further certain that the actual mortality of the country can be reduced. Many of the destroyers are visible, and can be controlled by individuals, by companies, and by corporate bodies, such as explosions in coal mines, drowning in crazy ships, railway collisions, poisonings, impurities of water, pernicious dirts, zymotic contagions, crowdings in lodgings, mismanagements of children, neglects of the sick, and abandonment of the helpless or of the aged poor " (*Supp. 35th. A.R.*, p. viii).

Under every item named by Farr there *has* been improvement, but relatively the improvement in respect of mortality not due to violence has been greater than in respect of violent deaths. As

we have noted, part of the explanation is that in modern times the instruments of violence have multiplied. We may expect the multiplication to continue. Unless the experience through which so much of the world is now passing excites such a passionate hatred of the air that aeroplanes are classed with opium and proscribed—a fantastically improbable exhibition of herd intelligence—civil aviation may well compete seriously with motoring as a cause of death. Should it be possible to keep pace with or surpass the increasing risks? That is a question the statistical investigator is not qualified to answer.

DISCUSSION ON PROFESSOR GREENWOOD'S PAPER

LT.-COL. W. BUTLER, in proposing a vote of thanks to the authors of the paper, said he thought it was difficult to criticize a statistical paper, particularly when, as in the present instance, the authors confined themselves so severely to a statistical outlook. If one were to pass any criticism it would be that they had refrained from pursuing " escape literature " to the extent of departing from a strict statistical method and endeavouring to discover what lay behind the statistics.

He thought, contrary to Professor Greenwood's remarks at the opening, that the subject would make a strong appeal to all. Violence had appealed to men at all times; it had been the subject-matter of our greatest dramatists and, dealt with statistically, one must be tempted to go behind the bare figures. It was rather remarkable that Buckle in his *History of Civilization* should have taken this field of statistics as a ground for the principles which he endeavoured to develop in the course of that work. To speak of accidents statistically and to treat them methodically was a paradox, because, statistically treated, deaths from violence due to accidents disappeared, they became deaths not from accidents but deaths from well-defined and known causes. The growth of what was known as street accidents, the enormous increase in those due to vehicular traffic in the period of motor transport, was one of the most stupendous facts with which they were faced. There was nothing in vital statistics so alarming as this persistent increase. As Professor Greenwood had said, if they were also to be faced with an increase from the further development of air transport the outlook was certainly grim.

The attitude the authors had taken with reference to the group of accidents known as overlaying was open to criticism. He was not familiar with Brend's paper, and it was perhaps unfair to criticize a paper one had not read, but one would want a lot of convincing that the doubling of deaths on Saturday nights could be due to a natural cause such as pneumonia or bronchitis. Moreover, there was evidence that these deaths were the result of a very unhygienic practice, and endeavours had been made to reduce them. With

regard to the figures of Table VI (deaths from suffocation), it was very curious that up to 1891–1900 they increased materially and after that period they declined.   The increase was more difficult to explain than the decrease.   Why should those figures increase ?   The decline was to be ascribed to improved habits which had been brought about very largely as a result of persuasive effort.   Some thirty years ago, when he was Medical Officer of Health of Willesden, he was much interested in the deaths due to overlaying.   They were particularly high in his district, varying from 2 to 3 per thousand, which was more than double the rate set out in the Tables.   In 1904 one was beginning to tackle the question of infantile mortality and one of the causes of this which it might be possible to reduce was overlaying.   Overlaying obviously could not occur if a more hygienic practice were observed of the mother sleeping away from the baby.   At that time there was no compulsory notification of births, but when births were registered the health visitors of the district visited the mothers, and that was one of the definite subjects of instruction.   Pamphlets were issued in which the mothers were told how undesirable it was that baby and mother should sleep together, and the reasons and the unhygienic nature of the practice were pointed out.

Some three or four years later, in 1908, the Notification of Births Act was passed, but up to that time no reduction took place, and enquiry elicited the fact that at least two-thirds of the babies slept with their mothers.   Moreover, it was during the first few weeks of life that one-fifth of these deaths occurred.   After the passing of the Act all the mothers were promptly visited by the health visitors, and from that time onwards the rate fell to 0·6 or 0·7 per thousand—more than halved.   The decrease was no doubt due in some measure to these efforts, and attempts to reduce infantile mortality were at that time intensified throughout the country.

Suicide, the authors said, had always been a subject of interest to all kinds of people as well as to the statistician.   That the increase in suicide in comparatively recent years should have shown itself mostly in the increase in suicides from gas poisoning was in accord with the facts that had generally been established with regard to suicide.   "How oft the sight of means to do ill deeds makes ill deeds done," and nowhere was that more true than of the intending suicide.   The soldier shot himself, the photographer poisoned himself with cyanide, the housewife and her husband apparently selected the oven, which was at hand and afforded an easy way of exit. He thought probably (and that appeared to be the view of the authors) that the facility of having an instrument at hand by which a painless death could be brought about was one of the causes of the increase.   Suicides were not often persistent; at all events many suicides could be prevented, as shown by the fact that after prosecution they did not resort to it again, and if they were saved at the time the impulse was strong the chance of a suicide was very much reduced.

Another rather unsatisfactory feature about suicide was that they were approximating more to the habits of the Germans, who

had always had a very much higher suicide rate than the British and continued to do so. It was not because the British were approximating to the German in type, but the German was intellectual, and suicide was an affliction of the intellectuals—the animals, so far as he knew, did not commit suicide. The more removed from the animal the greater the tendency to suicide because of the development of the nervous temperament. The resulting instability found an expression in suicide increase.

There were other points on which he would have liked to cross swords with the authors, but it was difficult to get one's teeth into a paper so severely statistical. There was very little with which to disagree and very little to supplement. Statistics were descriptive; they were not, as Buckle said, a means of discovering unchangeable laws, yet they would be very uninteresting if they did not suggest practical ways of dealing with the facts that they described. In proposing the vote of thanks he wished personally to thank the authors for a paper which remained interesting despite the fact that it afforded the critic little to say. In its most perfect form a statistical paper was indisputable.

DR. ISSERLIS said Colonel Butler had indicated very clearly that there was very little room for a learned criticism of the paper. It was a straightforward piece of descriptive work of a set of data based on interesting material. His chief reason for seconding the vote of thanks was that it gave him the opportunity of expressing his pleasure and the gratitude of the Society as a whole that at the first meeting of the session a paper was put before them from such experienced hands as those of the authors.

Professor Greenwood had contributed many papers, some long, some short, all weighty, but never tedious because illumined by a slightly sardonic wit, and the present paper was not an exception. He wondered whether it was an accident that out of $8\frac{1}{2}$ galleys, 4 were devoted to one not very clearly defined form of death by violence, that was to say, suicide. But to a certain extent, of course, all the deaths in this paper were those of the Registrar-General's definition.

Not being an expert in vital statistics he was a little puzzled to understand why privation of food was removed from the list of deaths in 1861, but death from starvation was added in 1911. He rather thought that in the Registrar-General's opinion they were two different things, unless it was that one Registrar removed one kind of death by violence in 1861 and in 1911 another Registrar thought that another form of death by violence had by accident been omitted.

One's interest naturally was not in the Registrar-General's compendious collection of figures but in the detailed analyses which the authors said were to be found in other reports. He had noted with interest the remarks in the paper on deaths by suffocation and those of Colonel Butler. With regard to deaths by drowning in crazy ships, a different section of returns would have to be referred to for these, and there was something analogous to the " Saturday night " in them. The President would be familiar with the returns

of deaths of seamen and fishermen, and it would appear that a seaman could die on board ship, on shore, he could die on his way from ship to shore, and he could also die on his way from shore to ship, and the fourth of these statistical units exceeded the third considerably. He did not know whether that had been analysed and whether " Saturday nights " headed the list. When he mentioned this statistical fact to a friend who had spent many years in the Navy he said this might be so in the Merchant Navy, but when he was a junior officer it was his business to see the liberty men safe from shore to ship, and these deaths did not happen on His Majesty's ships.

There was one piece of information which he hoped the authors would supply. Over and over again he saw figures relating to teachers, omitting music teachers. Was there any information about teachers of music?

His last remarks were a little more serious and dealt with the last paragraph of the paper. It was true that as mechanical invention proceeded new dangers were created. Perhaps the first, though not exactly a mechanical invention, was when someone taught a horse to carry him on his back and a new cause of death by violence arose—people could be thrown from a horse.

Mention was made of the decrease in natural deaths and increase in deaths by violence, but had not the successive helps given by science to daily life contributed to the decrease in natural deaths, and was there not some definite correlation between the deaths added by the new dangers and the deaths which were saved at the same time by the addition to the means of life? Both the authors of the paper and Colonel Butler would probably correct him, because he knew nothing of vital statistics, but he thought that if the deaths of children from summer diarrhœa were added to the deaths from road accidents and the total was compared with the corresponding total of forty years ago it would be found that the motor car had displaced the microbe bred in the stables near the centres of population (he knew, of course, that the work of the health departments would have suppressed infantile diarrhœa in time) and the coming of the car had thus had a beneficial effect. It was not a certainty that when the aeroplane did come into daily and common use that there might not be some compensation just as there was in the other.

It had been a great pleasure to attend an opening meeting, and he thought the thanks of the Society were due to the three authors who had found time in their busy lives to prepare a paper. He had great pleasure in seconding the vote of thanks.

Dr. Bradford Hill said that a study of the time trend of any specified cause of death was invariably very difficult owing to changes in the certification of causes of death and in methods of tabulation. One might well think that these factors would be of relatively little importance in deaths from violence—that a sound bump on the head was always a sound bump on the head—but Professor Greenwood and his colleagues showed that this was not so. For instance,

deaths attributed to violence at one time might be attributed to tetanus or septicæmia at another. Other components of the group, as Dr. Isserlis had pointed out, had changed curiously, and it had not occurred to him that at an early age one might have died a violent death from lack of breast milk while at a maturer age one might die a similar death from too frequent resorts to other forms of liquid refreshment.

Under modern conditions of certification and tabulation Professor Greenwood noted that in the County of London in 1938 4·5 per cent. of the total deaths were attributed to violence. The experience of a large town might perhaps be regarded as relatively unfavourable, but in fact the figure for England and Wales for the same year was very slightly higher, namely 4·8 per cent. There might be some interest in seeing how much addition had been made to these deaths in the present phase of world lunacy. For this one could take the figures published by the Ministry of Home Security for the 6 months August 1940 to January 1941. These seemed to be representative of the course of events, the August bombing being widespread but generally ineffective, that of September and October comprising the heavy attack on the capital, that of November and December including heavy concentrations on various provincial cities, while in January the scale was generally slight. For these six months there were recorded 24,257 deaths of civilians from air raids on Great Britain. This was probably somewhat of an understatement, because he did not think deaths subsequently in hospital were always included. In the 5 years 1934–38 the average number of deaths in 6 months in Great Britain was 277,000 so that the deaths from air raids added just under 9 per cent. to the normal total—grim enough, but much less than was expected before the war. These figures were for the whole country; localization of the attack must, of course, have produced changes of a very different order in particular towns, but no figures were published by which one could measure them.

Turning to Professor Greenwood's tables, it seemed to the speaker that in Table IV there was shown an astonishing rise in a very short period from the mortality attributed to the motor cycle—6 or 7 deaths per million in 1912 and 1923, and 30, or just over 30, only seven or eight years later. Of course the total death-rate was very small, but taken in conjunction with other road accidents, it was, at one particular time of life, sufficient to make a "hump" in the curve of the probability of dying. Dr. Martin showed some years ago that in the years 1930–32 the probability of dying was rather higher in the early twenties than in the later; this had also been observed on the Continent, where the improvement in the late twenties had been attributed to the benefits conferred by conscription. Dr. Martin found that in this country it was due to young men killing themselves on the roads in the earlier years and not having quite so much propensity to do so in the late twenties. The rise in the death-rate shown in Table IV suggests that this "hump" might become increasingly pronounced.

Deaths due to burns and scalds also presented some points of

interest. Table V showed that males and females brought life to
an end by that method with about equal frequency up to the turn
of the century, but since then the female rates had been appreciably
higher than those of the males. Subdivision by age in Table VI
showed no improvement for male infants but probably a significant
decrease for females. At ages 1–5 both sexes showed the same
trend with a very satisfactory reduction in mortality. With smaller
families the mother could give more attention to individual children
and reduce the risks, but the change in the sex ratios at all ages
and in infancy was rather curious. Another sex difference was
shown by deaths from murder and infanticide. There was no sex
difference up to 1890 and after that a relatively excessive female
rate. Presumably when children were not particularly wanted at
all, the female child was wanted even less ardently.

Finally, speculating on the suicide rate, Professor Greenwood
had said that in the last war although the desire of the barbarians
to inflict mental suffering was no less than in 1940, their *powers* to
do so were less. The speaker was inclined to the view that those
present powers might lead to anger and an added determination
to preserve life, if it be possible, rather than to despair and methods
of escape. But only time, ably aided by the Registrar-General,
would be able to show.

Sir William Elderton thought " that negligence and unskilful
driving by a vanman was often as fatal as furious and skilful driving
by a cabman " might be linked up with the remarks about " Saturday
night " made by Colonel Butler and Dr. Isserlis.

If children were more likely to be overlaid on a Saturday night
than on any other night of the week then the cause could not be
pneumonia and he did not think Dr. Brend thought so either. A
contributory cause must be drink. Again, if figures giving the
mortality of road accidents according to the nights when they
occurred, showed Saturday night with a bad record he would suspect
drink on the part of driver, cyclist or pedestrian as a contributory
cause in " the negligence and unskilful driving." He thought it
had been pointed out that accidents occurred more frequently at
certain times of the late evening, but that could be attributed to
fatigue or darkness rather than to habits.

Dr. Hill had referred to the " hump " in the mortality curve
shown by Continental statistics in early manhood. So far as Norway
was concerned this was not due to accidents but to tuberculosis,
and that remark could also be applied to the German experience
after the last war and to some extent to Swedish statistics. It
would hardly apply recently in this country, although the " hump "
was noticed many years ago in early adult ages and at that time it
was probably due to tuberculosis.

Some portion of the gas-oven deaths would presumably have
been suicides even if a gas oven had not offered the final temptation,
and they would therefore expect to find that the extrapolated
figures given by the authors' curve would lie between the standardized
rates per million of all suicides and those excluding the gas oven,
and that was what the table showed.

In Table VIII there was a reference to the suicides of unoccupied people which showed a rate of suicide above the average. Perhaps the kind of nervous trouble that leads to suicide leads in its earlier stage to the person not being employed.

The vote of thanks was put to the Meeting and was carried unanimously.

DR. PERCY STOCKS, who was unable to come to the Meeting, sent the following comment in writing :—

The subject with which Professor Greenwood has dealt in his characteristic stimulating fashion has received scant attention from statisticians partly, I think, because it is usually regarded as rather dull and partly because until recent years violent deaths have been nobody's business in the official sense, apart from industrial accidents and homicide. It must be admitted that the Registrar-General's analyses of accidental deaths have suffered from obscurities in classification and that they have failed to provide much material for those who may have wished to study these deaths in relation to social factors. Unfortunately the classification in force from 1931 to 1939 proved unsatisfactory owing to the separation by the International Conference of 1929 of a group styled " Violent deaths of unstated nature," to which were allocated deaths (such as the " Found drowned " referred to in the paper) regarding which it was uncertain whether they had been suicidal, homicidal or accidental. Legal procedures over violent deaths vary so greatly in different countries, and the boundaries of this group have proved to be so indefinable, that international comparability, even with Scotland, has been almost impossible over the whole list of accidental causes unless by some happy thought the group has been subdivided into its components by cause. Even within our own country vagaries of Coroners' verdicts, and the practice of adjourning and not completing inquests when no evidence of suicide or homicide was forthcoming, have led to difficulties in classification. Consequently the Registrar-General urged, and finally persuaded, the 1938 International Conference to suppress this group of doubtful deaths altogether and to adopt the general principle in the 1940 classification that if a violent death has not been found to be due to suicide or homicide it should be presumed to have been accidental and classed as such. The disadvantages of this course will be small in comparison with its advantages. Other improvements in the List now in force are the collection into single groups of all deaths (from any immediate cause whatsoever except war) which arise from railway accidents, motor vehicles, other road transport, water transport, air transport, mine or quarry accidents, agriculture or forestry, and accidents due to other machinery. If one runs one's car into a river and is drowned it will perhaps be some comfort to know that statistically one has died from a motor-vehicle accident instead of being merely drowned; at any rate it will save statisticians a deal of trouble.

The difficulties of estimating appropriate populations at risk to various forms of accident are considerable, but in this connection an attempt is being made to distinguish occupational deaths from

others. More than one effort has been made to estimate populations at risk to road accidents, but without arriving at a solution. Nearly everyone is a pedestrian, but we cannot tell how many are cyclists nor how many ride in private cars. Another difficulty is that the place of accident is often far removed from the place of residence; the former usually has the greater interest to the investigator, but it is not always ascertainable from the death certificate. Nevertheless I agree that a fuller analysis of violent deaths by occupational and residential groups would at least furnish the data without which more complete investigations cannot even be attempted, and I hope that in the next Decennial Supplements it will be possible to pay more attention to accidental deaths than hitherto.

Professor Greenwood recalls that in the last war the suicide rate of females declined, and he flies a kite as to the possibly different result of the present conflict in which we have heard so much of the "war of nerves." In 1939 the female suicide rate was higher in the June quarter than in the corresponding period of 1938, but in the second half of the year it was lower; and in the gloomy first half of 1940 it fell below the rates for the first half both of 1938 and 1939.

When I ponder over the concluding theme of the paper I foresee that statisticians of the future will ask for more complete analyses of the causes of civil aviation deaths—but perhaps by that time those bothersome diseases will demand less attention, and we shall be nearer to the doctors' millennium when the only causes of death are violence and old age (or will it still be myocardial degeneration?).

Professor Greenwood in reply said, with regard to Colonel Butler's criticism of the narrow scope of the paper, that the authors had not expected when the work was done that the paper would be read at an open meeting, and had confined themselves to a study of the Registrar-General's Reports.

Colonel Butler had devoted much attention to a single sentence in the paper in which reference was made to Dr. Brend's work. He (the speaker) regretted that Dr. Brend's book had not been cited (an omission which would be made good in the *Journal*). Dr. Brend drew attention to the great discrepancy between the proportions of verdicts of suffocation in bed with others in the London Coroners' Districts for the year 1910. While in the South-Western and Westminster Districts taken together there was but 1 such verdict in 134 inquests on children under one year, the Western District had 22 in 133, the Central 68 in 271. In 1913, however, the deaths in the South-Western and Westminster districts rose to 13 and in 1914 numbered 20; before 1907 they had averaged 25. In other words, they were at a very low level from 1907 to 1911. During that period the coroner for these districts, the late Mr. Troutbeck, caused much dissatisfaction among the general practitioners of the area by requiring an autopsy in a very large proportion of cases and by having the examination made by an expert pathologist not by the reporting practitioner. Dr. Brend concluded that " in districts where the proportion of post-mortems is high, and where they are conducted by expert pathologists, very few cases of deaths

attributed to overlying occur, the inference being that general practitioners sometimes overlook the indications of death from natural causes if they are not distinct. This is not necessarily a reflection on their skill in other branches of medicine. I have already referred to the difficulty of detecting some cases of broncho-pneumonia except by an expert."

Dr. Brend gave other reasons and his argument if not conclusive, was cogent. Naturally neither he, nor anybody else, would doubt that if children did not occupy the mother's bed at all, the mortality from overlaying would fall. But if what happened in overlaying was that the mother began to suckle the child, then went to sleep and the suffocation was due to pressure against the breast, a cot was not a complete remedy. As even sober persons slept longer on Saturday nights than other nights, delay in discovering that an infant was ill might be greater, and so the proportion of inquest cases higher.

The only remark of Dr. Isserlis he would challenge was the statement that Dr. Isserlis knew nothing of vital statistics. He hoped that Dr. Isserlis's optimism would be justified. At least it was true that barbarians raining high explosives in this year of horror did less execution than natural causes of a generation ago. So we had some ground for hope that unintended slaughter in the future might be compensated.

Dr. Bradford Hill had really made that point. With regard to the " hump," tuberculosis was a factor as well as violence. He agreed with Sir William Elderton's remarks, and thought Dr. Stocks's remarks made a valuable postscript to the paper. He was grateful to the Society for the kindness with which they had received a rather dry and sharply defined paper.

As a result of the ballot taken during the Meeting the candidates named below were unanimously elected Fellows of the Society :—

Major L. D. Adler, B.Sc., M.B., Ch.B., D.P.H.
Francis John Anscombe.
Arthur Joseph Brown.
Herbert Philip Christopher Brown.
Walter Eric Bulley, B.A. (Com.).
George Campbell, B.Sc.
Natindra Mohan Datta, B.A., B.Sc., B.L.
H. A. Freeman.
Walter Hagenbuch, B.A. (Com.).
Eric Ernest Hodgetts
John Keith Horsefield.
Margaret Huber, B.Sc.
William Philip Jeffcock.
Tudor John Jones.
Oscar Kempthorne

Harvey Klemmer.
Frederick James Lingwood.
Alfred George James Lipscomb.
Frederick Strathmore Mahoney.
Philip Hubert Massey B.Sc. (Econ.).
J. E. Morton, LL.D., D.Sc. (Econ.).
John Leonard Nicholson, B.Sc. (Econ.)
Arthur Page, Ph.D.
Ronald Hugh Stowell Phillips.
Thomas St. Andrew Robertson.
Leslie Stuart Rudkin.
Nihar Kumar Sarkar.
Robert John Spencer.
Richard Morris Titmuss.
Jean Sydney Tyrrell, B.Sc.
Eric Wild, F.C.A
Werner Wiseman, B.Sc., F.R.Met.S.

Corporate Representatives.

Ian Macpherson, *representing* Messrs. Buckmaster and Moore.
George Eugene Fasnacht, *representing* The Nuffield College Social Reconstruction Survey.

MISCELLANEA.

SOME OBSERVATIONS ON THE POPULATION OF SOVIET RUSSIA AT THE CENSUS OF JANUARY 17TH, 1939.

BY S. P. TURIN, D.SC. (ECON.).

SOME interesting details of the U.S.S.R. Census of 1939 have been published in the Soviet press, illustrating its social structure, degree of urbanization, age composition, literacy and nationalities.

The total population, excluding the Western Ukraine and Western White Russia, was 170,467,186. (The present total population of the U.S.S.R., including the population of newly occupied former Russian territories, is about 193 million people).

This figure denotes an increase since the Census of 1926 of 23,439,271 or 15·9 per cent.

The population defined as urban more than doubled during these thirteen years, from 26·3 million in 1926 to 55·9 million in 1939. This huge increase was due chiefly to the growth of new small towns (called in Soviet Russia town hamlets (*Posselki*)), which was proceeding rapidly : in 1926 there were 709 cities and only 125 town hamlets, in 1939 the number of cities had increased to 922 and of town hamlets to 1448.

As a consequence there has been some decline in the rural population. Although in such areas there was a natural increase, since 1926 of 18·2 millions, migration to the towns (24·4 millions) more

Population (with families) according to Social Groups. Census 1939 (excluding Western Ukraine and Western White Russia)

Social group				Number of persons in millions	Per cent.
Workmen (town and village)	...	...	...	54·6	32·19
Employees	...	...	...	29·7	17·54
Collective farmers (Kolkhozniks)	...	...	...	75·6	44·61
Co-operative artisans ...	...	...	...	3·9	2·29
Non-co-operative artisans ...	...	...	...	1·4	0·82
Individual farmers (peasants)	...	...	...	3·0	1·78
Non-labour group [1]	...	...	...	0·6	0·04
Various [2]	...	...	...	1·2	0·73
Total	...	...	170·0	100·00

In this group are included middlemen, clergy, criminals, etc.
Those who have not indicated their occupation.

than swallowed this up. In 1926, therefore, the rural population was 120·7 millions, in 1939 114·5 millions, a decline of over 6 millions.

The Soviet press welcomes this decrease as a sign of progress in the mechanization of agriculture.

Some figures of the social distribution are given on p. 172.

The *age composition* of the total population, compiled by the Central Statistical Bureau, was as follows:

U.S.S.R. Census of 1939 (*excluding W. Ukraine, W. White Russia and the Far North*)

Age				Number (in millions)	Per cent.
Up to 7 years	...	...	...	31·4	18·6
8–11 ,,	...	...	...	16·4	9·7
12–14 ,,	...	...	...	13·3	7·9
15–19 ,,	...	...	...	15·1	8·9
20–29 ,,	...	...	...	30·6	18·0
30–39 ,,	...	...	...	25·3	14·9
40–49 ,,	...	...	...	15·2	9·0
50–59 ,,	...	...	...	10·9	6·4
60 and over ...	...	...	...	11·1	6·6
Total	...	...	...	169·5	100

Roughly one-half of the population, according to this table, was born after the Revolution of 1917.

" The population of the U.S.S.R.," remarks one of the Soviet periodicals, " comprises 76·2 million persons below the age of 20 or 45·1 per cent. of the total population. In England (1931) the population of the same ages was equal to 32·4 per cent., in France to 30·8 per cent. In other words the proportion of children and young persons is one and a half times as high in the U.S.S.R. as in England or France and very much higher than in other countries. This comparison is the best testimony of the might and potential possibilities of the country of Socialism and of the degradation of the countries of Capitalism."

In the Census of 1939 there are interesting data, illustrating literacy in the U.S.S.R., showing what has been achieved in this direction since 1926, and what remains to be done in the future.

At the beginning of 1926 there were 665 literate men and 371 literate women for every 1000 of each sex age 9 and over. At the beginning of 1939 the corresponding figures were 908 literate men and 726 literate women. The following figures compare the urban and rural sections of the population:

Literacy in the U.S.S.R. Censuses 1926 *and* 1939 *(Percentage of literate people of age* 9 *and over)*

	December 17th, 1926			January 17th, 1939		
	Men	Women	Men and women	Men	Women	Men and women
Urban population ...	85·3	67·6	76·3	95·7	84·0	89·5
Rural ,, ...	61·9	30·0	45·2	88·2	66·6	76·8
Total ...	66·5	37·1	51·1	90·8	72·6	81·2

Illiteracy in Soviet Russia still comprises one-fifth of the total population, and in rural districts the figure reaches one-quarter of the total population, and amongst women as many as a third.

The ethnographical distribution of the population in Soviet Russia was also registered at the Census of 1939, but the final results have not yet been published. The following preliminary figures throw some light on the *national* structure. (The data of the Census 1939 were collected by nationality only, whereas the census of 1926 also gave information on language spoken.)

National Composition of the U.S.S.R. Census 1939

(Millions)

Union Republics	Urban population	Rural population	Total
Russian S.F.S.R.	36·66	72·62	109·28
Ukrainian S.S.R.	11·20	19·76	30·96
White Russian S.S.R.	1·37	4·20	5·57
Uzbek ,, ...	1·45	4·84	6·29
Kazakh ,, ...	1·71	4·44	6·15
Azerbaidjan ,, ...	1·16	2·05	3·21
Georgian ,, ...	1·07	2·48	3·55
Armenian ,, ...	0·37	0·92	1·29
Tadzhik ,, ...	0·25	1·23	1·48
Kirghis ,, ...	0·27	1·19	1·46
Turkmen ,, ...	0·42	0·84	1·26
Total	55·93	114·57	170·50

The final results, in which the population of the Far North and probably that of the newly created Republics will be included, may change considerably the figures relating to the Ukrainians, White Russians, Karelians and Finns. There were, for instance, on January 17th, 1939, 252,559 Karelians and 143,074 Finns in the U.S.S.R.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

CONTENTS

1.—*Statistical Procedures and their Mathematical Bases.* By C. C. Peters, Ph.D., and W. R. Van Voorhis, M.A. McGraw-Hill Publishing Company, Ltd. 1940. $9'' \times 6''$. v + 516 pp. 31s. 6d. net.

This book is written largely from the angle of educational psychology. There is a great deal on correlation analysis, and chapters on significance of means, analysis of variance, factor analysis and experimental design. Unfortunately it contains a great many mistakes. There is not space here to record all those noted on a first reading, but the following will serve as examples :

On page 411 the authors give their first illustration of the use of the χ^2 distribution by applying it to a series of 14 cells in each of which the expected frequency is 2. Since they state later that " the chi-square technique is not sound unless the numbers in the cells are reasonably large," this cannot be attributed to ignorance alone.

A section on pages 84–89 is headed " Proof of Sheppard's Correction Formula." Only the correction to the second moment is derived, and then only for a normal population. In any case, the proof is not sound, depending on various slipshod procedures, such as the term-by-term integration of infinite series without reference to questions of uniform convergence.

The extent of the authors' grasp of statistical principles is, however, revealed most clearly by the following gem on pages 299–300.

" Let us assume that our errors make a normal distribution. Then the frequency of occurrence of a particular error would be given by the normal equation $y = y_0 e^{-\frac{c^2 x^2}{2}}$. The probability of the occurrence of a particular error would be y/N." Hence the probability of simultaneous errors $x_1 \ldots x_n$ is

$$P = \frac{y_0{}^n N^{-n}}{e^{\frac{c}{2}(x_1{}^2 + x_2{}^2 + \cdots x_n{}^2)}}$$

This equation " shows that the value of P is a fraction whose value depends upon the sum of the square of the errors. Since the value of the fraction is the greatest when the denominator is least the value of P will be the greatest when the quantity within parentheses is least. That is, we must minimize the sum of the squares of the

errors in order to obtain a maximum probability of the concurrence [sic] of these errors. From this standpoint, therefore, we have a partial explanation of the principle underlying the least-squares method used in many of our statistical developments." Partial is indeed the word. Why not equate the errors to zero, and so make sure of getting the right answer every time?

The proof-reading has been done with inexcusable carelessness. Professor Rietz' name is spelt incorrectly on pages 90, 158 and in the index, which results in its being in the wrong place; Professor Gumbel's on page 125, Professor Treloar's on page 403, Dr. Kondo's on the same page and Dr. Mordecai Ezekiel's first name on pages 247, 330 and 403. On page 301 we find " The value of this expression . . . turns out to be 0·05399. If the reader will turn to Table LXV he will find this value of z appearing opposite the number 2·00, which appears in the x/σ column." There is no Table LXV. If we look in Table XLIV we find, against 2·00, $z = 0·0540$.

One last example of the authors' individual treatment. It is well known that the square of the correlation ratio, being non-negative, has a positive mean value. Kelley has proposed the alternative statistic

$$\varepsilon^2 = \frac{(N-1)\eta^2 - (k-1)}{N-k}$$

where N is the number in the sample and k is the number of classes. This has a zero mean value, and values of ε^2 from different populations are more comparable *inter se* than values of η^2.

So far, so good. ε^2 may very well be a better descriptive statistic than η^2, and anything propounded by Professor Kelley carries great weight. But it should be evident to a child that a test of significance of η^2 is equivalent to one of ε^2, to which it is related by the above simple linear equation. Our authors, however, think otherwise. On page 355 we have this : " The interpretation of η was somewhat dependent on the size of the population and the number of classes into which it was divided. Furthermore, there was available no ' exact ' test of the significance of η. But ε is entirely free from these limitations. . . . In fact, the ε test of reliability gives precisely the same results as the F test of analysis of variance for a given problem."

This book could not be recommended for use by any student who was not working under supervision.   M. G. K.

2.—*The Development of Mathematics.* By E. T. Bell. McGraw-Hill Publishing Company, Ltd. 1940. 9″ × 6″. xi + 583 pp. 31*s.* 6*d.*

The excuse for noticing this book in a statistical journal lies in Professor Bell's last chapter, but it would be unjust to pass over the previous 22 chapters in complete silence. This is a stimulating and, in places, a fascinating book to the mathematician. It covers the period of mathematical history from the earliest times, but is no ordinary chronicle of mathematical events and memorabilia. It is a history of ideas, not of men or of theorems, and as such is a notable

advance on certain existing histories. Some of the judgments expressed are highly individual, but by no means arbitrary; and the author is remarkably up to date at both ends of his time-scale, including, for example, accounts of Neugebauer's recent researches on Babylonian mathematics and of Gödel's discomforting theorem of 1931 to the effect that the consistency of certain logical systems (including that of arithmetic) cannot be proved without invoking methods of proof outside the system.

Unfortunately for statisticians, their science acquired the dubious advantage of mathematical recognition too late to receive an extended treatment in this book. There are references to subjects of tangential statistical pertinence here and there—the origin of the theory of probability in de Méré's problem to Pascal, the use of difference equations in solving problems in probability in the eighteenth century, and so on; but statistics proper appears only in the final chapter, " Uncertainties and Probabilities," and even there has to share a place with recent developments in mathematical logic.

Professor Bell seems to be undecided whether the science of aggregates of variables as contrasted with the science of individual variables is a new idea in mathematics (though there is no doubt that it was a new idea in physics), and advances the opinion that " the mathematical theory of probability seems to have contributed less to modern pure mathematics than any other major division of mathematics. It has been parasitic, deriving its vitality from the sciences to which it attached itself." This may be true, though the concepts of aleatory variable, stochastic dependence and convergence in probability indicate new things to come. At present the theory of statistics is rejuvenating old branches of mathematics rather than inventing new ones, but it seems inevitable that, once the mathematical lumber room has been completely ransacked, creation will ensue.

One of Professor Bell's observations is worth a reference. There is a well-known text from Laplace usually rendered into English as ' the theory of probabilities is only common sense reduced to calculation," a dictum generally quoted with hearty approbation, particularly by those whose calculations have led to something in flat defiance of common sense. If the statement means anything at all, which is doubtful, it is not true. Professor Bell thinks that Laplace was joking, and indeed, if Laplace foresaw the literature on the basis of the theory of probability during the twentieth century, he must have been.   M. G. K.

3.—*Business Cycles : a theoretical, historical and statistical analysis of the Capitalist Process*. By Joseph A. Schumpeter. McGraw-Hill Publishing Company, Ltd. 1939. 9″ × 6″. Vol. 1, xvi + 448 pp.; 9″ × 6″. Vol. 2, ix + 449–1095 pp. 66s.

This is a difficult book, as the author himself admits. " It cannot be glanced through for sweeping results. It must be worked with. . . . Readers who do the work, master the method, follow up the suggestions, answer the questions will at the end of their labour be able to feel that they have really come to grips with what goes on

under the heading of Business Cycle." With this modest claim the reviewer would agree, but he must frankly admit that all he has done with the book is to read it; so he writes under a disadvantage.

The difficulty about business cycles is that they are so easy to explain. There are almost more theories in explanation than facts to be accounted for. Perhaps the most useful service one can do to Professor Schumpeter is to give a very brief account of his own position.

We start from the concept of a closed economic universe in a perfect stationary state. Everything goes on just as it has always gone on, and not only industries but individual firms go through their economic motions day after day without change. Competition is perfect, foresight is absolutely accurate and time has barely any meaning. It is apparently assumed as a matter of common sense that this Walras world would be possible and that it would be stable.

In the midst of this Garden of Eden there appears an Innovator with a New Idea. Goods are withdrawn from old purposes and put to new. Other members of the State fall for the Idea. Entrepreneurial activity comes into play. The effects of the innovation spread through the entire system, which moves towards a new position of equilibrium. Having reached that condition, the system settles down once more until another Innovator appears. It does not overshoot the mark in aiming at the equilibrium point and hence generate a perpetual oscillation. It produces an evolutionary movement resulting in a boom, but is not followed by a depression below the normal equilibrium state.

Such, in a few words, is Professor Schumpeter's model of economic progress; but he admits other causational influences inducing cycles in the universe, such as superimposed shocks from without and small oscillatory movements from within. Added to this we must be prepared to imagine several innovations working themselves out concurrently. The whole makes up the confusing and irregular fluctuation which is observed in Nature, and we may discern therein long cycles (Kondratieffs), intermediate cycles (Juglars) and short cycles (Kitchins). Theories of price, wages, money and interest rates may have their little parts to play in explaining these effects, but the arch-villain of the piece is the Innovator.

This takes us to the end of Chapter 4. Chapter 5 is a broad account of the statistical technique of the analysis of time series, not perhaps very clear to those who were ignorant of the subject beforehand. The next two massive chapters are invaluable historical analyses of past cycles, going back as far as 1787. This concludes the first volume.

In Volume 2 Professor Schumpeter puts his working model through its paces and, as the sub-title to the book indicates, is led to an examination of the economics of the capitalist system. There are chapters on The Price Level, Employment, Wages, The Interest Rate, The Central Market and the Stock Exchange, and two chapters on the periods 1919–29 and 1930–39. The basic phenomena in all these branches are explained in terms of the author's theory of economic evolution. On money Professor Schumpeter promises us another book.

There is one matter which a statistician cannot allow to pass without challenge. In reviewing a work on economics it is never entirely fair to take a passage from its context, but this is Professor Schumpeter's opinion of the rôle of statistics in economic theory (Vol. 1, pp. 32–33).

"No argument of weight can be gained from the physical analogy for the view that the right way to go about our task is to assemble statistics, to treat them by formal methods, and to present the results as the solution of a problem. The illusion underlying this view may be further exposed by an instance of what we may term Nonsense Induction. In every crisis or depression we observe that commodities become unsaleable. If, on the strength of this we say, 'People produce too much, hence they are, from time to time, unable to sell what they produce,' we are saying something for which there is really no warrant in the factual finding itself. . . .

"There is, along with Nonsense Induction, such a thing as Spurious Verification. An example will best show what it consists in. Starting from the common sense impression that the interest rate is an important factor in business situations, we may jump to the conclusion that it is the causal factor responsible for booms and slumps. In fact, almost always a low rate of interest precedes a boom and a high rate a slump. If this were enough to establish causal connection this proposition would be one of the safest in our science. Yet it is wrong and could be proved to be so, even if no statistical fact ever contradicted it. Nor is this all. Even if the proposition were correct, statistics could not prove it to be so, for it stands to reason that the behaviour of our time series which accords so well with it, could also be explained by another relation or on grounds perfectly free from causal implication—for instance, on the ground that every boom must be preceded by a state of things which we recognise as being the reverse of ' booming ' and that in such non-booming situations there is little demand for money and therefore a low rate of interest."

This is a magnificent opening for an epistomological wrangle, but we need not stop to ask Professor Schumpeter how he distinguishes a true cause from a spurious one (concomitant variation being excluded). Everything he says here is familiar to statisticians, and has inspired some of their best work, notably on partial associations and correlations and on nonsense correlations. It seems to me that he takes an unduly narrow view of statistics, which is not the science of numerical aggregates, any more than economics is the science of footnotes, but the science of interpreting and understanding them. Had Professor Schumpeter said that the mere accumulation of numerical material is insufficient to scientific enquiry without a leavening of insight, no one would have objected—every schoolboy has written on the theme that genius is one-tenth inspiration and nine-tenths perspiration—but what he has said is bound to annoy the statistician, who likes to imagine that he is an economist just as much as the economist likes to think himself a statistician. Statistical theory is only just making a start on the study of stationary time series, and may very well produce the analytical instru-

ments which will either uphold or destroy Professor Schumpeter's theories.

It is not easy to convey in a few words the height, breadth and depth of this book. One may disagree with Professor Schumpeter's findings here and there, and even with his basic conception of the economic process, but one is compelled to admire. Almost any book into which the author has put his whole heart is worth reading, and the factual presentation alone makes this a work to be studied. Economists who approach it with their own ideas about the business cycle will perhaps be prepared to scoff; but some of them will remain to pray.   M. G. K.

4.—*Studies in War Economics.* The International Labour Office, Montreal. (London: P. S. King. 1941.) 9″ × 6″. 199 pp. 4s.

This I.L.O. survey is a valuable collection of six essays on different aspects of one of the central economic problems of total war. The problem, which is outlined in the introductory essay, is how to maintain a balance between incomes devoted to war production and incomes devoted to the production of consumption goods. Taxation, compulsory saving and the limitation of wages can be used for the direct control of the volume and disbursement of incomes. The relative social merits of these measures and also the Keynes Plan are discussed. But such rigid methods of control can never produce a complete adjustment of free purchasing power to the supply of available consumption goods and, so far as this gap can be closed, voluntary savings must be relied upon to do this.

Among the problems discussed in the next chapter dealing with Relative Wages in War-time is that of " dilution " in the engineering industry. A shortage of skilled workers will create dangerous bottle-necks, but this does not necessarily work out to the men's advantage. Skilled men who are paid at time-rates may lose by the granting of less than proportionate cost-of-living bonuses and, at a later stage, may easily find that their earnings have become relatively less, as compared with those of the rapidly expanding body of unskilled piece workers. The extent of wages control varies from country to country : in Britain, there is compulsory reference of disputes to the National Arbitration Tribunal, and there are also subsidiary measures to prevent armament firms from outbidding one another and from " poaching " labour from other industries; France, Germany and Japan, on the other hand, have prohibited all advances in wages without special authorization.

To complete the organization of the war-economy, consumption as well as incomes must be controlled by fixing prices and rationing food and other necessities. Such an indirect control of expenditure will not only increase the amounts available for voluntary saving, and will thus counteract the widening of any inflationary gap, but it will also secure a socially fair distribution of supplies among all income groups. The next chapter describes how various countries have attempted to regulate food prices by controlling all increases (as has been done in the case of wages). This method puts the

onus of proving the need for a change on the producer, but that is its only advantage over other schemes of controlling prices on the basis of costs; all such schemes are notoriously difficult to work. This particular problem, however, need not arise where goods are imported or distributed under a government monopoly, as is done on a large scale in this country. Price-fixing can then be governed by some other criterion such as a policy of keeping working-class expenditure stable. Rationing and its effects on consumers' choice are also discussed, and the book contains further papers on Housing and Building Policy and on Changes in World Textile Trade since 1914.

Its wealth of examples taken from the experience of many countries, both in the last and in the present war, renders this book extremely valuable, and indeed if any justification were needed for the continuance of the work of the International Labour Organization in war-time, this survey would provide it.   M. R.

5.—*Studies in Economic Warfare.* By D. T. Jack, M.A. London: P. S. King, 1940. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. viii + 175 pp. *12s.*

The phrase "economic warfare" may be interpreted in many ways. In the widest sense it might cover the greater part of a nation's efforts in attack and defence, and in any case it is not easy to draw hard and fast lines between economic and the other factors and forms of activity favouring a successful conclusion to hostilities. Economic warfare is, for instance, necessarily mixed up with diplomacy and so-called international law. But with these two exceptions, the author of the book under review avowedly limits himself to the study of "economic action used as an attacking force against an enemy."

The narrowness of this definition is mitigated a little in that Professor Jack does not entirely ignore economic defence, and his conception of economic action is apparently wide enough to include the firing of torpedoes from submarines or shells from naval guns. Some of his most interesting data relate, in fact, to the number of U-boats used and destroyed and our merchant shipping losses in the under-water and above-water attacks of the last war. There is a melancholy interest, too, in reading that during the Napoleonic wars our loss of tonnage was approximately equal to our total tonnage on the register in 1792. But new building enabled us to emerge from that war with a larger mercantile marine than we possessed at the beginning of hostilities. In this first chapter, dealing with "Economic Warfare, 1793 to 1815," there is indeed much to keep the reader's mind continuously swinging backwards and forwards over the intervening century and a half. Much has changed and much has remained the same; many of the problems facing the country at that time appear once more to-day with very little change in outward appearance.

But in the next chapter we pass from reality to the author's study of modern developments in international law and numerous ethical and theoretical questions arising from it. The sudden change from the stark realities of war to this highly abstract sphere

may leave the reader with sensations resembling those of Alice when she fell down the rabbit hole.

But there is a return towards reality in the next chapter, which covers the diplomatic background to the economic warfare of 1914–18, and this leads up to a study of the actual policy and problems of the economic offensive during that period. Here the author gives much interesting statistical and other detail which throws light on the relative and varying effectiveness of different strategy and tactics in non-military warfare.

The final chapter, on economic hostilities in the present struggle, which is necessarily brief and rather spoilt by events that have happened since, ends with the relatively comforting conclusion that although German conquests have improved her supplies of raw materials for armaments, the decisive factor in the long run will be supplies of oil.

The general reader will find much in this book to interest and inform him. Others may wish that greater attention had been paid to the more positive and strictly economic methods of warfare, and to what may obviously be of decisive importance—the various possibilities of economic defensive warfare. But the author set out to deal only with certain aspects of the economic offensive, avowedly on historical lines, and within these self-imposed limits he is eminently successful.   C. O. G.

6.—*Juvenile Delinquency, a Comparative Study of the Position in Liverpool and England and Wales.* By J. H. Bagot, M.A. London: Jonathan Cape. 1941. 8½″ × 5½″. 93 pp. 5s. net.

This volume is concerned for the most part with an analysis of the circumstances of juvenile delinquents in Liverpool in the years 1934 and 1936. Liverpool, as the author states, is a city where the problem of juvenile delinquency is acute, and the author's knowledge of the city and its social problems serves him in good stead in his self-imposed task of probing the special problem of juvenile crime there. The results of Mr. Bagot's researches give us a vivid picture of juvenile delinquency in Liverpool concentrated in one section of the population—those who are badly off in the economic sense, and among this group those who are badly off in respect of many desirable social attributes. There appears to be little doubt of the association of poverty with delinquency, though no one can assert that poverty causes delinquency.

Mr. Bagot was also concerned with the rise in the amount of juvenile delinquency between the two periods reviewed. It is interesting to find that he concludes that part of the change may be attributed to causes other than changes in the nature of the juvenile himself. The amateur sociologist feels that his credulity is being extended beyond permissible lengths if the professional insists on a deterioration within a short time of the genus *puer*, but he is prepared to believe that an increase in juvenile delinquency in a short period may be partly due to changes in recording. Mr. Bagot suggests that changes in police procedure and changes in the attitude of the

public to juvenile crime account for a good deal of the increase recorded between 1934 and 1936.

It is a pity that Mr. Bagot was not able to compare more freely his delinquents with non-delinquents. There is a tendency to assume that what appears to be an associated factor is present in a group of delinquents to such an extent that it is likely to be a predisposing factor to delinquency. Mr. Bagot says that " the majority of the delinquents have very little pocket money and it is the desire to enjoy what others have that leads to the stealing of money." This may be true, but many people will not believe it, and there is no proof that it is true. Again, the author reports that in many instances of delinquents the free treatment of various physical defects offered by the School Medical Officer had not been accepted. Similarly, for anything we know to the contrary, similar offers made to non-delinquents may have been refused. These refusals on the part of the parents may indicate conditions of home life unsuitable to the correct development of the boy or girl, but such conditions may exist in the general population apart from the delinquent group.

Sometimes the statistical inferences are not altogether fair. For instance, Mr. Bagot finds that 22 per cent. of the offences are committed on Sundays, and 9 per cent. on Fridays. He remarks that many premises are unoccupied on Sundays, but, *per contra*, he did not say that they were more carefully guarded on Fridays. Again, referring to stealing by girls from open-counter shops on Saturdays, he says that these shops are very busy on Saturday afternoon and evening, but surely the point is that a lot of people, including girls, have their weekly afternoon and evening " off " on Saturdays. The thefts take place on Saturdays because the girls have flocked to the shops then in their free periods and other people have done the same thing, and consequently the shops are crowded. It is difficult to believe that girls rest at home during the week waiting for crowded shops on Saturdays in order to commit thefts.

The author is to be congratulated on the presentation of his thesis. The book is easy to read, and should convey a good idea of the problem of juvenile delinquency in this country to-day.

E. C. R.

7.—*The Excess Profits Tax : a Practical Exposition.* By H. E. Seed, A.C.A., A.S.A.A. 2nd. Ed. London : Gee and Co. 1940. $8\frac{1}{4}'' \times 5\frac{1}{2}''$. xxvi + 348 pp. Price 20s.

The second edition covers legislation up to the Finance (No. 2) Act, 1940. The alterations made by the Finance Act, 1941, are to be covered by a short supplement obtainable free of charge. It is difficult to criticize the publishers for this makeshift arrangement. The new legislation, which deals with the treatment of borrowed capital, will take time to digest, and meanwhile there is risk of losing the market.

The first eight chapters contain a topical exposition of the Acts, assisted by numerous examples. So far, no E.P.T. cases have come before the Courts, and the cases cited refer to the old Excess Profits

Duty.   Whether these will turn out helpful remains to be seen. Coming to some of the more elusive points of the tax, the treatment of wear and tear is adequate, and the author rightly emphasizes that the meticulous computation of capital is not always necessary.   In other directions, treatment leaves something to be desired, especially as regards disallowable items of profit and their subsequent emergence in the guise of capital; and capital losses.   At what stage has a loss to be written out of capital, and how is its treatment affected by prior allowances of wear and tear and current allowances for obsolescence ? These points, and others, would have been brought out had the author adopted the " self-balancing " method of computation. Admitted, some practitioners do not like the method, but the author does not seem even to have heard of it !   The treatment of re-distri-buted items of expense is sketchy, and the author has not considered whether the re-distribution should be allowed to affect capital or not.

Chapter IX, which deals with subsidiary companies, is sketchy, and does little to clear up the real difficulties.   This is not surprising, since the drafting of the Acts is almost unintelligible, even to the Inland Revenue authorities themselves.

A print of the Acts is included in the Appendix, and there is an adequate index.   The book gives a sound and readable introduction to E.P.T. from the practitioner's standpoint.   It is much better than some with more pretentious claims.   L. R. C.

STATISTICAL NOTES

1. BRITISH OFFICIAL STATISTICS

IT was announced in the House of Commons on February 27th that it had been decided that it would be contrary to the national interest to continue to publish the monthly Trade Accounts, because even the limited information published since the outbreak of war was of potential value to the enemy. The usual statistical notes on oversea trade must accordingly be suspended for the period of the war.

The rise in general *Wholesale Prices* during the four months, January to April 1941, was not considerable, and the Board of Trade index-number registered an advance of only 1·5 per cent. during the period, i.e., from 148·6 in December 1940 to 150·9 in April 1941 (average for 1940 = 100). One reason for the smallness of the advance is, of course, the number of articles the prices of which are controlled and for the most part stationary. The over-all prices of the food and tobacco groups show, indeed, a slight fall, the index-numbers declining from 144·5 to 144·0, although there were fluctuations in both directions within the groups. There was an advance in the general level of industrial materials and manufactures of about 2·5 per cent., due chiefly to increases of rather more than 6 per cent. in the price of cotton and of 3 per cent. in the prices of other textiles, excluding wool. There were small increases, round about 3 per cent., in chemicals and miscellaneous materials, but the prices of coal and metals, all of which are controlled in one way or another, with the exception of tin, showed hardly any change. There was, however, an advance in the price of tin (standard, cash) of about £13 per ton —£256·10 to £269·55. As regards cereals, both barley and maize declined in price, and imported wheat advanced. There was a fall in egg prices and a rise in those for potatoes, both of which were seasonal, and there were advances in the prices of bacon, coffee, and cocoa.

Compared with April 1940 the index-number advanced about 14·1 per cent., the groups for food and tobacco about 14·6 per cent., and those for materials and manufacture about 13·9 per cent. There was an advance of rather more than 20 per cent. in building materials, and in articles of food other than cereals and meat, of 23·5 per cent. Paper-making materials rose very steeply in price, and the price of rubber advanced about 28 per cent. There was very little movement in non-ferrous metals, and textiles other than cotton showed but slight advances. Cereal prices remained fairly steady with the exception of maize.

Since the beginning of the war general wholesale prices had risen nearly 54 per cent. by April 1941. The rise was greatest in basic materials (excluding fuel)—73·6 per cent., and prices of cotton and wool and of articles of food other than meat advanced between 60 and 70 per cent. The rise was least in non-ferrous metals (23·3 per cent.), building materials (32·8 per cent.), coal (32·9 per cent.), and chemicals (35·7 per cent.). All of these fluctuations have to be considered in relation to the control exercised by the Government as regards prices and supplies and to the subventions granted in respect of a number of articles of food.

The Board of Trade index-numbers of wholesale prices for recent months are given below, together with the increases in April 1941 over April 1940 and August 1939.

(Average of prices for 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Inter-mediate Products	Manu-factured Products	Building Materials
Dec. 1940 ...	144·5	150·4	148·6	158·2	160·7	144·3	132·8
Jan. 1941 ...	144·7	151·7	149·5	159·5	161·4	145·9	136·3
Feb. ,, ...	144·3	152·9	150·0	161·0	162·6	147·0	137·7
Mar. ,, ...	144·1	153·9	150·8	163·6	163·6	147·3	137·7
Apr. ,, ...	144·0	154·2	150·9	164·1	163·7	147·6	138·2
Apr. 1940 ...	*125·7*	*135·4*	*132·2*	*152·1*	*136·7*	*130·4*	*114·8*
Aug. 1939 ...	*90·4*	*102·2*	*98·1*	*94·5*	*104·0*	*108·7*	*104·1*
Percentage in-crease of April 1941 over—							
Apr. 1940 ...	14·6	13·9	14·1	7·9	19·8	13·2	20·4
Aug. 1939 ...	59·3	50·9	53·8	73·6	57·4	35·8	32·8

The figure for certain other British index-numbers of wholesale prices and the index-number of wholesale prices prepared by the U.S. Bureau of Labor are given below.

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866-77 = 100)	*The Times* (1913 = 100)	United States Bureau of Labor (1926 = 100)*
Dec. 1940 ...	148·6	100·9	134·5	165·2	79·8
Jan. 1941 ...	149·5	102·5	134·9	166·3	80·4
Feb. ,, ...	150·0	103·3	136·3	166·0	80·4
Mar. ,, ...	504·8	104·3	138·0	166·4	81·1
Apr. ,, ...	150·9	104·3	141·1	169·6	82·8
Apr. 1940 ...	*132·2*	*93·7*	*126·0*	*146·0*	*78·3*
Aug. 1939 ...	*98·1*	*70·3*	*90·4*	*114·5*	*74·8*

Mean of weekly prices.

According to the Bank of England index-numbers of the prices of primary products in the United Kingdom and the United States there had been by the end of April 1941 an advance since the war of 37·5 per cent. in the prices of such products in Great Britain as compared with an advance of 28·5 per cent. in the prices of the corresponding products in the United States.

According to the index-number prepared by the Ministry of Labour, there was an advance of about 1½ per cent. in the *retail prices* of food, and of other articles generally consumed by working-class families, during the first four months of the present year. This was chiefly due to advances in the prices for clothing. The prices of food remained fairly stationary, although there was an advance of about 2*d.* per lb. in bacon prices in March, compensated to some extent by reductions in the prices of milk and eggs. The advance in prices of clothing since the beginning of the year is estimated to amount to rather more than 10 per cent. Since the end of August 1939, clothing prices have risen about 76 per cent, prices of food and also of fuel about 24 per cent., of other articles of consumption about 25 per cent. The over-all increases in the cost of living has amounted to about 29 per cent. Working-class rents have risen only slightly owing, no doubt, to the large proportion of the houses being rent-controlled. There is, however, a great scarcity of housing accommodation in many districts.

The index-numbers for the period 1st January, 1941, to 1st May, 1941, are given below.

(Average prices for July, 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
Jan. 1st, 1941 ...	172	164	330	223	222	196
Feb. 1st, ,, ...	171	164	340–345	225	223	197
Mar. 1st, ,, ...	169	164	350	225	224	197
Apr. 1st, ,, ...	170	164	355–360	225	226	198
May 1st, ,, ...	171	164	365	226	226	200
May 1st, 1910 ...	*159*	*164*	*280*	*208*	*210*	*180*
Sept. 1st, 1939 ...	*138*	*162*	*205–210*	*180–185*	*180*	*155*

During the past year, the *index number of agricultural prices* has, naturally, shown a substantial increase, the general index for the year 1940 recording the highest average for any year since the end of the last war. In 1939 there was not, on the whole, much change compared with the two preceding years, though the upward movement began to manifest itself in November and December.

The commodities included in the general index are divided by the Ministry of Agriculture into three groups, and the fluctuations in these groups and in the general index are shown below for the past five years. The figures take account of the subsidies payable in respect of wheat, barley and oats, cattle and milk.

(Base 1927–29 = 100.)					
	1936	1937	1938	1939	1940
Cereals and farm crops	93½	98½	86	91½	124½
Live stock and live stock products...	79½	88	88	90½	121½
Fruit, vegetables and glasshouse produce	86	93	105½	88½	145½
General index	82½	90½	90	90½	125

All commodities showed an increase in 1940 over 1939, especially in the second half of the year, so that the monthly index for December 1940 for cereals and farm crops was 142 and for live stock and live stock products 133, figures which may be compared with the pre-war averages in August 1939 of 80 and 93. Since the end of 1940, further rises have been recorded so that the cereal monthly index in May 1941 was 160 and the live stock index 143. These increases have, of course, been accompanied by greater costs of production, but no figures are available on this point.

Comparison with the figures ruling in the last war shows that the 1940 index of 125 is about midway between the averages for 1916 and 1917. The old index of agricultural prices, adjusted to a basis corresponding with the present series of index numbers, reached 110 in 1916 and 139 in 1917. In 1918, the index was 160.

In connection with the above figures of prices, the annual estimate prepared by the Ministry of Agriculture of the *value of the agricultural output* for 1938–39 is of interest, though it refers to a period prior to the outbreak of war. These estimates are based on the assumption that the agricultural land of England and Wales forms, as it were, one large farm, and they accordingly represent the value of the quantity of produce sold by farmers to the non-farming community. The figures for the past five years are given on p. 189, together with the additional sums received by farmers in respect of wheat, cattle, barley and oats.

The value of the output in 1938–39 was less than in the preceding year, but the increased amount of the subsidies, especially for wheat, brought the total to over £233 millions, a figure which was practically identical with that for the year 1925, and one which

(Millions of £.)

	1934–5	1935–6	1936 7	1937–8	1938–9
Live stock and live stock products...	138·7	141·7	147·0	155·1	154·6
Farm crops	35·9	36·0	39·8	35·3	31·8
Fruit and vegetables	23·8	20·0	23·7	25·0	24·3
Glasshouse produce, etc.	8·1	8·5	8·8	8·8	8·7
Total	206·5	206·2	220·2	224·2	219·4
Subsidies :					
Wheat	6·4	5·2	1·3	1·8	8·8
Cattle	1·9	2·7	2·8	2·8	3·1
Barley and oats	—	—	—	0·1	2·1
Total	214·8	214·1	224·3	228·9	233·4

has not been reached since that year. No corresponding figures are available for the last war.

Unemployment continued to diminish during the four months since the middle of January 1941, and the number of unemployed workpeople on the registers of the employment offices of the Ministry of Labour in Great Britain fell from 695,606 on 13th January to 368,988 on 12th May. The number on the registers at 20th May, 1940, was 880,822. Of the 368,988 on the registers at 12th May, 1941, 36,393 men and boys and 4,021 women and girls had been classified by interviewing panels of the Local Employment Committees as unsuitable for ordinary industrial employment. The reduction in the numbers unemployed was considerable during February and March but not so great as might be expected in April and May in view of the continued absorption of men into the armed forces. There was a continuance of the high proportion of women on the registers but, as has been stated previously, this is probably due to applications from women who are not ordinarily seeking for industrial work or who are seeking to renew such work after a prolonged absence. Reports indicate that the demand for men in the coal-mining and building industries was specially acute. The total number of all classes of workpeople on the registers hardly indicates a figure sufficient to meet fully the day to day requirements. Temporary stoppages in certain occupations and demands in others, together with changes in the locality of industries, must of necessity cause a large daily ebb and flow in the registers.

The table on p. 190 shows the number of workpeople (insured and uninsured) on the registers of the Employment Offices of the Ministry of Labour and National Service in Great Britain.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Jan. 13th, 1941 ...	521,388	152,381	21,837	695,606	371,695	323,911
Feb. 10th, ,, ...	448,975	114,235	17,639	580,849	303,548	277,301
Mar. 17th, ,, ...	364,308	75,691	17,919	457,918	231,336	226,582
Apr. 21st, ,, ...	318,772	75,373	16,366	410,511	214,549	195,962
May 12th, ,, ...	290,312	65,744	12,932	368,988	181,823	187,165
May 20th, 1940 ...	*730,773*	*102,730*	*47,319*	*880,822*	*587,997*	*292,825*
Aug. 14th, 1939 ...	*968,108*	*211,978*	*51,606*	*1,231,692*	*947,099*	*284,593*

During the first five months of 1941 the *rates of wages* of work-people have been increased to an estimated amount of £1,000,000 per week, and since the commencement of the war the total estimated increase in rates has amounted to about £4,000,000. These figures exclude any advances granted to agricultural labourers, domestic servants, shop assistants and clerks, and Government employees and take no account of any increased earnings due to increased hours of labour or overtime worked.

2. OTHER STATISTICS

During the three months February to April 1941, the total value of retail sales shows but a slight increase over the sales for the corresponding period three months of 1940. From the statistics prepared by the Bank of England in collaboration with various retail distributors' Associations and Co-operative Societies it would appear that there was an increase as compared with 1940 of 0·5 per cent. in food sales and of 0·8 per cent. in the sales of other classes of goods, giving a combined increase of 0·6 per cent. Bearing in mind the considerable advance in retail prices in almost all articles the statistics point to a noticeable reduction in consumption.

The index-number of the value of wholesale trading in textiles prepared by the Bank of England and the Textile Association showed a marked decline compared with the sales of the first four months of 1940. The mean index-numbers for the periods were 98 in 1941 and 121 in 1940. The index-numbers for the export trade which were 82 and 87 respectively show a somewhat smaller fall than those for the home trade which was in the region of 24 per cent., viz. 99 and 123.

CURRENT NOTES

A VERY important publication issued by the League of Nations has just been received by the Society. This is *Europe's Trade*, a special study emanating from the Economic and Financial Section and dated December, 1940. It replaces the annual *Review of World Trade*, which could not be prepared in 1940 because of the curtailment of national trade statistics. The study relates to the trade of Europe as it was before the war. Mr. Loveday, in a preface, states that the general objects are " to consider what was the part played by Europe in the trade of the world, how far Europe was dependent upon external markets and external markets dependent upon her, to estimate the importance to her of what, in the absence of a better term, is known as Empire trade, and to illustrate the commercial and general economic interdependence of different parts of the continent." The analysis is set out under the following divisions :—Magnitude and composition of European Trade. Europe's intra-trade and trade with the rest of the world. Trade with the British Dominions, India and Europe's oversea territories. Europe's trade balance. Directions of trade and distribution of trade balances. Europe's trade in certain products. Summary of tendencies during the 'thirties.

Relative tables are given in four Annexes. The fourth is of especial interest at present, as showing the net imports into Europe (both including and excluding the United Kingdom and Eire) of a long list of foodstuffs and raw materials before the outbreak of war.

This elaborate investigation was made possible by the generosity of the Rockefeller Foundation, and it is hoped to prepare a subsequent volume dealing with the trade of the rest of the world.

The American Statistical Association has lately published an Index to its *Journal*, Volumes 1 to 34, covering the 52 years 1888–1930. The number of volumes does not correspond with the number of years because before 1924 each volume covered two years. Until 1922 the title was Quarterly Publications of the American Statistical Association.

This Index, as the preface explains, has been prepared " to make more readily available to statisticians and research workers the great store of professional knowledge concerning techniques, data, and critical analysis " published in the *Journal*. It is essentially a subject index, for although there is an index of authors, this latter is simply an alphabetical list of names with " blind "

references to page numbers, and there is nothing which connects any writer with any article. The subject index is full; details of a main subject are set out as subheadings, and there are ample cross-references. The type is clear and satisfactory on the whole. Main headings are in large capitals; main sub-headings (i.e., those which have sub-headings under them) in clarendon lower case. Other entries, however, whether main or sub-entries, are all in lower case without capital initials (except for proper names), so that only the indenting distinguishes the independent from the dependent items, and it takes a little time for the eye to sort them out.

The preparation of the Index was made possible by a grant from the Rockefeller Foundation, and many statisticians will share in the gratitude expressed by the compilers. Inevitably they will also reflect that such an index covering a number of the principal statistical periodicals would be a still greater boon to research workers.

The Society has learned, through an obituary notice in the *Revista de Economia y Estadística* issued by the University of Cordoba, Argentina, of the death, on October 12th, 1940, of Professor Gino Arias, the well known Italian economist. Since 1939, when he left Italy for political reasons, he had been living in the Argentine and held the Chair of the Faculty of Law at Tucumán until his appointment, early in 1940, as Director of the Seminary of Economics and Finance and Professor of Political Economy in the University of Cordoba, where his erudition and zeal won high appreciation. He died suddenly while on his way to take his class. The circumstances of his enforced exile were no doubt in great part responsible for his untimely death.

Professor Arias was born in Milan in 1878. He took his degree at Pisa in 1900 and later occupied in succession the Chairs of Political Economy at the Universities of Genoa, Florence (where he afterwards became Dean of the Faculty of Law), and Rome. His best known book is the *Principii di Economia Commerciale*, published in 1917; much or most of his work, however, was contributed to Italian economic periodicals. In 1934, responding to the demands of the new generation, he produced a *Corso di Economica Politica Corporativa*.

OBITUARY

Lord Stamp, G.C.B., G.B.E., F.B.A., D.Sc., LL.D.

The death of Lord Stamp by enemy action on April 16th is a severe loss to many circles, as was shown by the numerous letters of appreciation of his services and his personality that appeared in the Press. Here it is appropriate to speak of him only as a statistician and economist. The combination of theoretical economist, technical statistician, ex-civil servant, railway chairman, director of the Bank of England, and (to some extent) economic advisor to the Government, in one person is unique in our time, and indeed it is difficult to name any comparable figure in an earlier generation.

Born in 1880, Josiah Charles Stamp entered the Civil Service in 1896, and while on the provincial staff of the Inland Revenue worked for the external degree of the University of London, which he obtained with first-class honours in 1911. His work at that date attracted the attention of Graham Wallas, and on his invitation Stamp entered as an internal student at the London School of Economics and began the preparation of his most important published work, *British Incomes and Property*, for which the degree of D.Sc. was duly awarded. His regard for the School of Economics never wavered, and as Vice-Chairman and subsequently Chairman of the Court of Governors his continuous and detailed advice was of the greatest advantage. He was appointed as one of the Statutory Commissioners under the London University Act, and was a signatory to its Statutes, having been a Member of the Senate since 1924. In later years he appears only under " Other Persons " as a member of the Board of Studies for Economics and Political Science (including Commerce and Industry). He is listed as an Honorary Doctor of eleven Universities, and as examiner in three of them and in London. He also gave two courses of Newmarch Lectures.

Meanwhile his ability was recognized at the Board of Inland Revenue and he was transferred to the Secretariat in 1914 and was Assistant Secretary in 1916. It is understood that the preparation and working of the Excess Profits Duties was his major task. He resigned in 1919 and began his career in commerce and industry as successively Director of Nobel's and of Imperial Chemical Industries, and became Chairman of the L.M.S. Railway on the amalgamation of the L.N.W. and Midland lines. In public affairs his best-known work was in connection with Reparations, and the recommendations of the Dawes' report in 1924 are believed to be mainly based on his suggested plan.

His connection with the Royal Statistical Society dates from 1911, when, on coming to London, he became a Life Fellow. In 1914 he communicated a note on Pareto's Law, which was incorporated in his *British Incomes*. As Sir Josiah Stamp, K.B.E., he appears as one of the Honorary Secretaries in 1920, an office which he retained till his election as President in 1930. Two of the six Papers he read to the Society were on Profits—" Effects of Trade Fluctuations on Profits," 1918; " Industrial Profits in the Past Twenty Years," 1932—the latter was his Valedictory Address as President, and in it he introduced the now well-known index of profits. Three were on National Income or Capital; for the first of these, " Wealth and Income of the Chief Powers," 1919, a silver Guy Medal was awarded. The second, " The National Capital," formed the inaugural Presidential Address in 1931. The third, " Methods Used in Different Countries for Estimating National Income," was read at the Centenary Meeting of the Society, the occasion also of the Jubilee Meeting of the International Institute of Statistics, which was held in London in 1934. The final paper (1936), " Influence of the Price Levels on the Higher Incomes," was of less importance.

Sir Josiah Stamp was elected as Member of the International Institute of Statistics in 1924, but there is no record of his attendance at any Session till London in 1934. At the next Session (Athens, 1936), he was elected Treasurer, and he was also present at Prague, in 1938.

Of the numerous other Institutions to which he was attached, not infrequently as one of the principal officers, mention must be made of the National Institute of Economic and Social Research. Of this he was one of the chief originators, and through his influence adequate financial support was secured. From the beginning he was President, and till the outbreak of war took a regular part in its administration.

His principal statistical and economic work is contained in seven books :—

British Incomes and Property, 1916.

The Fundamental Principles of Taxation, 1920. New Edition, 1936. (Newmarch Lectures).

Wealth and Taxable Capacity, 1922. 2nd Edition, 1922. Reprinted, 1930. (Newmarch Lectures).

Studies in Current Problems in Finance and Government, 1924. 2nd Impression, 1925.

Some Economic Factors in Modern Life, 1929.

The National Capital and other Statistical Studies, 1937.

The Science of Social Adjustment. 1937.

The four last named are collections of papers and addresses given on various occasions, and include some of those already named as communicated to the Royal Statistical Society, and also his Presidential Address to Section F of the British Association, 1926.*

The general intention and scope of these papers are best described in two extracts from the Prefaces.

> " It is perhaps necessary to warn the general reader that there is very little actual exposition of received or recognized economic doctrine in these pages. The studies represent nothing more than the way in which my own particular experience and mode of economic thinking has reacted towards these problems, and are, therefore, only an individual approach to them." (*Current Problems*.)

> " The development of [economics] lies to an important extent in specialist works upon such particular aspects as Currency, Foreign Trade, Demand and Supply, Taxation. . . . All of these, however, proceed from the centre of economic theory outwards. But the realistic economic life meets all the streams of practice, custom and ideas impinging on it, infiltrating it at a score of different points, and conditioning and modifying it as ' Economics.' Why not sometimes change the direction of study and drift *from* outside on some of such streams *into* the heart of economic territory ? " (*Economic Factors*.)

The papers in general show wide reading, full knowledge alike of the economic problems involved and of the statistical technique that had been applied to them, intimate acquaintance with practical aspects, and originality in outlook and treatment.

Some personal reminiscences may not be out of place, for I have been closely associated with some of the many aspects of his activities since he was first nominally under my supervision as a post-graduate student in 1911. Then my most vivid recollection is of numerous discussions of Pareto's Law, which found their place in *British Incomes*. Subsequently, whenever I attended a committee, whether at the School of Economics, the British Association, the Economic Advisory Council, or the National Institute, I expected to find him occupying some important office, arriving punctually from some important engagement, in complete command of all detail, patient to gather opinions, and ready to offer appropriate decisions. At Prague in 1938, when the International Institute was considering the advisability of closing the Session and the members were search-

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* *National Income in 1924,* Bowley and Stamp, is published otherwise. While the whole is a joint production, it may be said that he was mainly responsible for the treatment of " income-tax income ", while I was responsible for that of wages.—A. L. B

ing out the safest way home, he appeared direct from Nuremburg at an evening gathering, and standing in the middle of the room, looking like the embodiment of the British Empire, restored some measure of confidence. Nevertheless the next day he was summoned to fly back to England to deal with railway problems of mobilization and evacuation, and the Session was closed at a midnight meeting of such officers as could be found. At Athens in 1936 he was President of the Economic Section. He also had a semi-official mission to Greece, but his attendance appears to have been regular. According to the official report of the final séance :—" La Séance est ouverte à 18*h*.30 sous la présidence de Sir Josiah Stamp. Then follow short abstracts of papers by M. Evelpidi and M. Pogus. M. le Président est particulièrement heureux de constater le nombre et la grande valeur des communications qui ont été adressées à la Section par les auteurs grecs. Il remercie particulièrement les auteurs de ces communications.— La Séance est levée à 18*h*.40." After 18*h*.40 I was aware of his movements till a late hour. At 9*h*. the next day it was his duty to make a formal report of the whole work of his Section. That report, which was given verbally and without hesitation, occupies seven pages of the Bulletin. I asked him when he had prepared it, and he replied, " During the reading of the Report of the President of the first Section."

Finally there was the dinner in his honour on the occasion of his elevation to the Peerage. This was a small and intimate gathering, to which persons who had been his closest associates, from the time he was a junior civil servant, in his many ascending spheres of activity, were invited, together with some whom he had named as having especially influenced his outlook on life. The spontaneous expression of personal affection and gratitude by those who spoke of their association with him, and his direct and familiar reply, showed that the source of his great influence was not only marked intellectual power and quite unusual quickness of thought, but also sympathetic appreciation and understanding of those who had worked with him.

A. L. BOWLEY.

STATISTICAL AND ECONOMIC ARTICLES IN
RECENT PERIODICALS

UNITED KINGDOM—

Annals of Eugenics, April 1941—Data for testing for genetic linkage on 500 pairs of sibs : *William C. Boyd and Lyle G. Boyd.* The detection of linkage. II. Further mating types; scoring of Boyd's data : *D. J. Finney.* On the problem of rank and the limiting distribution of Fisher's test function : *P. L. Hsu.* Canonical reduction of the general regression problem : *P. L. Hsu.* The distribution of the largest of a set of estimated variances as a fraction of their total : *W. G. Cochran.*

The Banker—
> *March* 1941—The consequences of exchange laxity : *P. Einzig.* American aid and the dollar problem : *P. Einzig.* The settlement of inter-Empire payments : *P. Bareau.*
> *April* 1941—Central banking under German occupation : *P. Einzig.* Securities under the defence regulations : *C. J. Shimmins.*
> *May* 1941—Why defend Nazi trade methods? : *P. Einzig.* South America's export problem. The national finances.

Bankers' Magazine--
> *May* 1941— A new economic policy. The 1941–42 Budget.
> *June* 1941—Economic policy after the war.

Economica, February 1941- Development of industrial production in the U.S.S.R. : *A. Baykov.* The inter-relations of shipping freights : *W. Arthur Lewis.* Rising supply price : *Joan Robinson.*

Economic Journal, April 1941—Hitler's " New Order " in theory and practice : *P. Einzig.* The German war economy in economic periodicals : *H. W. Singer.* Public opinion and paying for the war : *Charles Madge.* The new Federal Reserve Board index of production : *G. Stolper* and *E. M. Doblin.* Obituary—James Bonar : *Prof. G. F. Shirras.* Obituary - H. W. Macrosty : *Sir H. Llewellyn Smith.*

Eugenics Review, January 1941 - Economic effects of a declining population : *Francois Lafitte.* Study of racial mixture in the British Commonwealth : *K. L. Little.*

Institute of Actuaries, Journal, Vol. 21, I, 1941—A note on the Registrar-General's reports on occupational mortality in England and Wales in connexion with recent censuses : *Henry Brown.* The recent trend of mortality in England and Wales : *W. S. Hocking.* Discontinuity in the force of mortality : *Sir William P. Elderton.* Tests of a mortality table graduation : *H. L. Seal.* The treatment of deaths due to war. An extract from notes entitled " The Actuary in War " : " *Loafia.*"

Institute of Bankers, Journal, April, 1941—Invention as an economic factor in war and peace : *W. F. Crick.*

United Kingdom—*Contd.*

Oxford Economic Papers, September 1940—The trade cycle in Britain before 1850 : A postscript : *Sir William Beveridge.* Studies in mobility of labour : Analysis for Great Britain, Part II : *H. Makower, J. Marschak* and *H. W. Robinson.* The multiplier : *G. Dowell.* The short-term rate and the long-term rate : *M. Kalecki.* Consumption savings, and war finance : *E. A. Radice.*

Oxford Institute of Statistics, Bulletin—

January 1941, *No.* 1—General rationing : *M. Kalecki.*

February 1941, *No.* 2—The cost of living index : *J. L. Nicholson.* Working-class budgets in October : Analysis of dietary : *T. Schulz.* Development—Projects in Great Britain during the war : *P. W. S. Andrews.* Export policy since the outbreak of war : *G. D. N. Worswick.*

February 1941, *No.* 3—The Ministry of Labour Budget Inquiry : 1. The cost of living index : *J. L. Nicholson.* 2. Standards of nutrition in 1918 and 1937–8 : *T. Schulz.* Notes on the cotton industry : 1. The future of the industry : *G. D. N. Worswick.* 2. The " spreadover " in weaving : *T. Balogh.* Food policy : *P. W. S. Andrews.*

March 1941, *No.* 4—Budgets of old age pensioners and households on public assistance : *T. Schulz.* The shipping situation : *S. Moos.* Concentration in the " non-essential " industries : *T. Balogh* and *F. Burchardt.* Signs of inflation : *J. L. Nicholson.*

April 1941, *No.* 5—A " human needs " diet in war-time : *T. Schulz.* Prospects of the tobacco trade : *S. Moos.* Concentration in the hosiery industry : *G. D. N. Worswick.* The role of compensation in the economic system : *T. Balogh.*

April 1941, *No.* 6—A. The Budget of inflation : *M. Kalecki.* B. The Budget and economic mobilisation : *T. Balogh.* Concentration in the Leicester hosiery industry : *G. D. N. Worswick.*

April 1941, *No.* 7—The Balkan war and the blockade of Germany : *S. Moos* and *E. J. Buckatzsch.*

May 1941, *No.* 7—The release of labour from the cotton industry : *G. D. N. Worswick.*

June 1941, *No.* 8—What is inflation : *M. Kalecki.* Economic incentive and efficiency in war industry : *J. Steindl.* Economic aspects of the cinema trade : *D. B. Halpern.*

Public Administration, January 1941—Town and country planning—Compensation and betterment : *Sir Gwilym Gibbon.* Some notes of the Ministry of Labour family budget enquiry 1937 : *E. Grebenik.* War policy of the British and German social insurance schemes : *Harald von Waldheim.*

Review of Economics Studies, February 1941—The rehabilitation of consumers' surplus : *J. R. Hicks.* The measurement of changes in real income under conditions of rationing : *E. Rothbarth.* Lags in tax collection—A neglected problem in

UNITED KINGDOM—*Contd.*

war finance : *U. K. Hicks.* Capital accumulation, employment and price rigidity : *T. De Scitovszky.*

Royal Agricultural Society of England, Journal of, March 1941— Notes on farm mechanization in war time : *W. H. Cashmore.* The milk supply in time of war : *Norman C. Wright.* Heredity in farm animals : *J. Edwards, A. Walton* and *J. Hammond.*

Royal Society of Edinburgh, Proceedings of, Session 1939–40—The design and interpretation of experiments based on a fourfold table : The statistical assessment of the effect of treatment : *W. O. Kermack* and *A. G. McKendrick.*

Statistical & Social Inquiry Society of Ireland, Journal of the, Ninety-third session, 1939–40—Tables in continuation of those published in paper entitled " Financial results in mixed dairy farms in 1937–38 " : *M. Murphy.* Poverty as a cause of ill-health : *James Deeny.* Investigation into the incidence of mental deficiency amongst Dublin school children : *Dr. Louis S. Clifford.* The impact of war upon Irish economy : *J. F. Meenan.* The social income of the Irish Free State, 1926–38 : *Prof. G. A. Duncan.*

INDIA—

Indian Journal of Economics, January 1941—A simplified version of the trade cycle theory—I : *B. N. Adarkar.* The rôle of national wage and income structures in international trade : *J. S. Raj.*

AUSTRALIA—

Economic Record, December 1940—The 1936 Maori Census : *E. P. Neale.* Production costs on four west Australian wheat farms : *F. O. Grogan.* New Zealand's war economy : *W. B. Sutch.* Some aspects of war finance : *K. S. Isles.* Maximum and equity in relation to the Empire's war effort : *H. R. Randerson.*

SOUTH AFRICA—

South African Journal of Economics, December 1940—The war and its effect on agricultural prices and surpluses in South Africa : *S. D. Newmark.* Problems of resource transfer in war : 1. The war and the Budget : *J. N. Reedman* and *P. H. Guenault.* 2. Exchange policy and import control : *J. N. Reedman.* 3. Labour supply : *P. H. Guenault.* 4. Price control in wartime : *Prof. H. R. Burrows, I. G. Halliday* and *R. H. Smith.*

UNITED STATES—

American Economic Review, February 1941—Papers and proceedings of the Fifty-third Annual Meeting of the American Economic Association, New Orleans, Louisiana, December 1940.

UNITED STATES—*Contd.*

March 1941—Work—relief wage policy : *A. E. Burns* and *Peyton Kerr.* Armaments program and national income : *J. Linde-man.* Rearmament, recovery and monetary policy : *G. L. Buch.* Economics in a time of change : *F. C. Mills.*

American Statistical Association, January 1941— Some State competitive examinations in statistics : *G. W. Snedecor.* Repeated interviews as a tool for studying changes in opinion and their causes : *P. F. Lazarsfield.*

March 1941—On tables " reproduced " in text-books : *C. Eisen-hart.* Notes : Recognizing statistical standards and attainment : *E. C. Bratt.* Duties of a statistician in an Agricultural College : *W. D. Baten.*

April 1941—The interpretation of tests of significance (note) : *C. Eisenhart.*

Annals of American Academy of Political and Social Science, January 1941—New horizons in radio : Problems and progress of sound broadcasting and future developments in the radio field (whole number). Billions for defense : How can the American people pay the costs of rearmament? (whole number).

Annals of Mathematical Statistics, March 1941—Asymptotically most powerful tests of statistical hypotheses : *A. Wald.* Experimental determination of the maximum of a function : *Harold Hotelling.* On a statistical problem arising in routine analyses and in sampling inspections of mass production : *J. Neyman.* A concise analysis of certain algebraic forms : *F. E. Satterthwaite.* A symmetric method of obtaining unbiased estimates and expected values : *P. L. Dressel.* Determination of sample sizes for setting tolerance limits : *S. S. Wilks.* On a certain class of Orthongonal polynomials : *F. S. Beale.* The skewness of the residuals in linear regression theory : *P. S. Dwyer.*

Econometrica, January 1941— The method of minimized areas as a basis for correlation analysis : *E. B. Woolley.* The problem of assigning a length to the cycle to be found in a simple moving average and in a double moving average of chance data : *E. L. Dodd.* Confluence analysis by means of lag moments and other methods of confluence analysis : *O. Reiersøl.*

Federal Reserve Bulletin, April 1941—-United States Government corporation and credit agencies, 1940. Banks and the defense program.

Millbank Memorial Fund Quarterly, January 1941— Chronic disease among middle and old-age persons : *Jean Downes.* Medical evaluation of nutritional status : *D. G. Wiehl.* Class birth rates in England and Wales, 1921–1931 : *J. W. Innes.*

April 1941—Pre-war European population policies : *G. F. Mc-Cleary.* The influence of nutrition education in families of the Mulberry area of New York City : *Dorothy L. Bovee* and *Jean Downes.* Intra-group difference in birth rates of married women : *C. V. Kiser.*

UNITED STATES—*Contd.*

Monthly Labour Review, March 1941—Extent of week-end shutdowns in selected defense industries : Employment and earnings in 1940.

Political Economy, Journal of, February 1941—The capital–deposit ratio in banking supervision : *R. I. Robinson.* Industrial Europe at the time of reformation (ca. 1515–ca. 1540) : *J. U. Nef.* Annual saving and underspending of individuals, 1926–1937 : *G. S. Fulcher.* Graphical survey of economic developments. External aspects of a war and a defense economy : The British and American cases : *S. E. Harris.* Defense financing and inflation potentialities : *A. H. Hansen.*

Social Research, February, 1941—Lack of confidence : *J. Marschak.* The Hermann Göring works : *Kurt Lachmann.* Conscription of capital : *Arthur Feiler.*

Wheat Studies of the Food Research Institute, April 1941—Rice and wheat in world agriculture and consumption : *V. D. Wickizer.* Wheat in the post-surplus period 1900–09 with recent analogies and contrasts : *H. C. Farnsworth.*

ARGENTINA—

Revista de Economia y Estadística, 1940, *Nos.* 2 *and* 3—Estacionalidad de las principales series de importacion en la Republica Argentina (conclusion).

JAPAN—

Kyoto University Economic Review, April 1940—The economic thought in the middle period of the Tokugawa Era : *Prof. E. Honjo.*

SWITZERLAND—

Zeitschrift fur schweizerische Statistik und Volkswirtschaft, 1940—II—Bericht über die Massnahmen zur Inflationsverhutung in der Schweiz, dem Eidgenossischen Volkswirtschaftdepartement erstattet von der Kommission fur Konjunkturbeobachtung und der Preisbildungskommission : Die Bilanz der schweizerischen Banken 1939 vom Statistischen Bureau der Schweizerischen Nationalbank.

INTERNATIONAL—

International Labour Review, February 1941—International comparisons of food costs : *R. M. Woodbury.* Some aspects of German social policy under the National-Socialist Regime : *P. Waelbroeck* and *I. Bessling.*

March 1941—A scientific labour policy for industrial plants : *P. Sargant Florence* and *Lella Florence.*

April 1941—Latin America and the International Labour Review : *D. H. Blelloch.*

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part I, 1941, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom.

Office of the Parliamentary Counsel. Defence Regulations. 7th ed. 15th Jan. 1941. London: H.M.S.O., 1941. 9¼″ × 6″. xii + 368 pp. 5s. 6d.

Select Committee on National Expenditure, Session 1940–41. Reports : 3rd. 14 pp. 3d. 4th. 48 pp. 9d. 5th. 11 pp. 2d. 6th. 67 pp. 1s. 7th. 4 pp. 1d. 8th. 8 pp. 2d. 9th. 14 pp. 3d. 10th. 8 pp. 2d. 11th. 7 pp. 2d. 12th. 26 pp. 6d. 13th. 5 pp. 2d. 14th. 40 pp. 9d. 15th. 10 pp. 2d. London : H.M.S.O., 1941. 9¼″ × 6″. 13 parts.

Treasury. An analysis of the sources of war finance and an estimate of the national income and expenditure in 1938 and 1940. London, H.M.S.O., 1941. Cmd. 6261. 9¾″ × 6″. 16 pp. 3d.

(b) British Empire.

Eire—

Department of Industry and Commerce. Ireland. Census of population 1936. Vol. VIII, Irish language, with special tables for the Gaeltacht areas. Dublin : Stationery Office, 1940. 10″ × 6¾″. xi + 108 pp. 2s.

Union of South Africa—

Office of Census and Statistics. Report on road safety research. I. Road vehicle accident statistics, 1939. II. First report of the Road Safety Committee, 1940. Pretoria : 1940. 12″ × 9½″. xlviii + 70 pp. 6s.

(c) Foreign Countries.

Argentina—

Dirección General de Estadística. Clasificacion estadistica de las causes de las defunciones (Nomenclatura internacional de 1938). (Informe No. 77.) Buenos Aires : 1940. 10½″ × 7½″. 38 pp.

Czechoslovakia—

[*Brno Municipal Council, Statistical Department.*] The Munich agreement of the 29th September 1938 and the land of Moravin-Silesia in the Czechoslovak Republik. [Brno] n.d. 12″ × 18″. 18 pp., 7 maps & diagrams. (From the Czechoslovak Research Institute.)

Sweden—

Statistiska Centralbyrån. Den animaliska produktionen år 1937–1938. (Statistiska meddelanden Ser. A. Band V : 8) Stockholm : 1941. 9½″ × 6½″. vi + 51 pp.

—— —— Jordbruksräkningen ar 1937. Stockholm : 1941. 9½″ × 6½″. xii + 76 + 342 pp.

(d) International.

International Labour Office—

Year-book of labour statistics. 5th year of issue. 1940. (Geneva : 1940. (London : P. S. King.) 9½″ × 7½″. viii + 175 pp 8s.

(d) **International**—*Contd.*

League of Nations—

> *Economic Intelligence Service.* Europe's trade : a study of the trade of European countries with each other and with the rest of the world. Geneva : 1941. London : Allen and Unwin. (Printed by Princeton University Press, N.J., U.S.A.) $10\frac{3}{4}'' \times 8''$. 116 pp. *5s.*

II.—AUTHORS AND MISCELLANEOUS

American Statistical Association. Index to the Journal. Volumes 1–34, 1888–1939. Washington, D.C. : 1941. $9\frac{1}{4}'' \times 6''$. iv + 102 pp.

Barlow (*Peter*). Barlow's tables of squares, cubes, square roots, cube roots and reciprocals of all integer numbers up to 12,500. Edited by *L. J. Comrie*. 4th ed. London : E. & F. N. Spon : 1941. $8\frac{1}{4}'' \times 5\frac{1}{2}''$. xii + 258 pp. *8s. 6d.*

Crick (*W. F.*). An outline of war-time financial control in the United Kingdom. London : Macmillan, 1941. $7\frac{1}{2}'' \times 5''$. 59 pp. *6d.*

Dodge (*H. F.*) and *Romig* (*H. G.*). Single sampling and double sampling inspection tables. (Bell Telephone System technical publications. Sampling Monograph, B-1274.) New York : 1941. $9'' \times 6''$. 61 pp. (From the authors.)

Instituto de Economia Sancho de Monaeada. Anales de economia. Vol. I, Número I, Marzo 1941. Madrid : 1941. $10'' \times 7''$. 160 pp.

Karachi Cotton Association Ltd. Karachi cotton annual 1939–40. No. 7. Compiled and published by *T. B. Dalal.* Karachi : 1941. $9\frac{3}{4}'' \times 6\frac{1}{4}''$. vii + 85 + 57 + 21 pp. *Rs.* 2.

Kendall (*M. G.*). Proof of Fisher's rules for ascertaining the sampling semi-invariants of k statistics. Reprinted from *Annals of Eugenics*, 10, Pt. 2, pp. 215–22, 1940. $11'' \times 8''$.

—— The derivation of multivariate sampling formulæ from univariate formulæ by symbolic operation. Reprinted from *Annals of Eugenics.* 10 Pt. 4. pp. 392–402, 1940. $11'' \times 8''$.

—— A theory of randomness. Reprinted from *Biometrika.* XXXII. Pt. 1 Jan. 1941. Pp. 1–5. $10\frac{3}{4}'' \times 7\frac{1}{2}''$.

—— A recurrence relation for the semi-invariants of Pearson curves. Reprinted from *Biometrika*, XXXII. Pt. 1. Jan. 1941. Pp. 81–82. $10\frac{3}{4}'' \times 7\frac{1}{2}''$. (From the author.)

Liverpool (University of) Social Science Department : Statistics Division. Redeeming the time : a survey of the junior instruction centre movement. *Owen E. Evans.* (New Merseyside series 13.) Liverpool : The University Press, 1941. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 63 pp. *2s. 6d.*

Mannheim (*Hermann*). Social aspects of crime in England and Wales between the wars. London : Allen & Unwin, 1940. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 382 pp. *18s.*

Mills (*Frederick Cecil*). Statistical methods applied to economics and business. Revised ed. New York : Henry Holt, 1939. (London : Pitman.) $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xix + 746 pp. *18s.*

Neyman (*J.*). On a statistical problem arising in routine analyses and in sampling inspections of mass production. (Reprinted from *Annals of Mathematical Statistics* XII, No. 1. Mar. 1941. Pp. 46–76.) (From the author.)

Seed (*H. E.*). The excess profits tax : a practical exposition. 2nd ed. London : Gee & Co. 1941. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xxvi + 348 pp. *20s.*

Statesman's year-book : statistical and historical annual of the states of the world for the year 1941. Edited by *M. Epstein.* London : Macmillan, 1941. $7'' \times 4\frac{3}{4}''$. xxxvi + 1487 pp. *20s.*

Suviranta (*Br*). War indemnities and capital levy in Finland. Supplement to Svenska Handelsbanken's *Index.* Stockholm : March 1941. $9'' \times 6\frac{1}{4}''$. 24 pp.

Tucker (*Rufus S.*). Real wages under laissez-faire : what a new index of retail prices covering 142 years shows. (Photostat copy of " *Barron's* " *the national financial weekly.* Oct. 23, 1933. Pp. 6–7.) $19'' \times 13''$. 2 pp. (From Dr. J. Kuczynski.)

REGISTRATION OF THE UNITED KINGDOM

No. I.—ENGLAND AND WALES

A.—Births, Deaths, *and* Marriages : *Numbers and Annual Rates per 1,000 persons living.   Deaths under 1 year of age : Mortality per 1,000 Live Births in the Calendar Years 1936–1940 and in the Quarters of those years.*

Years	1936		1937		1938		1939 *		1910 "	
Estimated Mid-Year Popln. in thousands	40,839		41,031		41,215		41,460 *		41,460 *	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	605,292	14·8	610,557	14·9	621,204	15·1	619,352	14·9	607,131	14·6
Stillbirths ...	25,045	0·61	24,806	0·60	24,729	0·60	24,309	0·59	22,618	0·55
Deaths	495,764	12·1	509,574	12·4	478,829	11·6	498,968	12·1	572,882	14·3
Marriages ...	354,644	8·7	359,160	8·8	361,768	8·8	439,694	10·6	468,267	11·3
Infant Mortality	35,425	59	34,917	58	32,473	53	30,927	50	33,638	55
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	148,035	14·6	145,405	14·4	155,187	15·3	153,382	15·0	151,336	15·0
Apr.–June ...	157,652	15·5	163,777	16·0	164,179	16·0	161,306	15·9	166,537	16·2
July–Sept. ...	155,596	15·2	158,590	15·3	158,082	15·2	161,023	15·4	149,219	14·3
Oct.–Dec. ...	144,009	14·0	142,785	13·8	143,756	13·8	140,641	13·5	137,009	13·1
	Stillbirths									
Jan.–Mar. ...	6,378	0·63	6,268	0·62	6,185	0·61	6,295	0·62	6,198	0·61
Apr.–June ...	6,502	0·64	6,619	0·65	6,639	0·65	6,362	0·62	5,969	0·58
July–Sept. ...	6,067	0·59	6,000	0·58	6,072	0·58	5,946	0·57	5,354	0·51
Oct.–Dec. ...	6,098	0·59	5,919	0·57	5,833	0·56	5,706	0·55	5,127	0·49
	Deaths (excluding Stillbirths) †									
Jan.–Mar. ...	153,591	15·1	163,716	16·2	137,897	13·6	151,232	15·1	204,349	20·3
Apr.–June ...	119,540	11·8	118,525	11·6	119,188	11·6	120,529	11·7	118,055	11·8
July–Sept. ...	99,935	9·7	100,301	9·7	102,545	9·9	103,127	9·9	108,880	10·9
Oct.–Dec. ...	122,698	12·0	127,032	12·3	119,199	11·5	121,080	11·8	141,598	14·2
	Marriages									
Jan.–Mar. ...	49,884	4·9	70,700	7·0	52,159	5·1	47,121	4·6	108,792	10·6
Apr.–June ...	100,621	9·9	80,265	7·8	102,290	9·9	102,816	9·9	116,131	11·2
July–Sept. ...	115,445	11·3	121,121	11·7	116,559	11·2	152,930	14·6	131,251	12·6
Oct.–Dec. ...	88,694	8·7	86,774	8·4	90,760	8·7	136,827	13·1	112,087	10·7
	Infant Mortality									
Jan.–Mar. ...	11,947	81	10,636	73	10,523	68	9,974	65	11,876	77
Apr.–June ...	8,583	54	8,835	54	7,933	48	7,828	48	7,681	46
July–Sept. ...	6,795	44	6,795	43	6,540	41	6,358	40	6,316	42
Oct.–Dec. ...	8,100	56	8,651	61	7,177	52	6,763	49	7,765	57

* Provisional.   † Excluding deaths of non-civilians after 2 Sept., 1939.

No. II.—SCOTLAND

BIRTHS, DEATHS, *and* MARRIAGES : *Numbers and Annual Rates per* 1,000 *persons living. Deaths under 1 year of age : Mortality per* 1,000 *Live Births in the Calendar Years* 1936–1940 *and in the Quarters of those years.*

Years	1936		1937		1938		1939		1940	
Estimated Mid-Year Popln. in thousands	4,972		4,979		4,985		5,010		5,030	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	88,928	17·9	87,810	17·6	88,627	17·7	86,899	17·4	86,403	17·1
Stillbirths ...	Not separately recorded						3,832	42	3,796	42
Deaths ...	66,749	13·4	68,942	13·9	62,953	12·6	64,413	12·9	72,775	14·9
Marriages ...	37,896	7·6	38,331	7·7	38,716	7·8	46,257	9·2	53,597	10·6
Infant Mortality	7,315	82	7,050	80	6,163	70	5,955	69·0	6,766	78
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	22,541	18·3	21,589	17·6	22,245	18·1	21,429	17·4	22,113	17·7
Apr.–June ...	23,594	19·1	23,864	19·2	23,999	19·3	23,015	18·9	23,285	18·6
July–Sept. ...	21,464	17·2	21,745	17·3	21,423	17·0	21,549	17·1	21,154	16·7
Oct.–Dec. ...	21,326	17·1	20,612	16·4	20,960	16·7	20,306	16·1	19,838	15·5
	Stillbirths									
Jan.–Mar. ...	—	—	—	—	—	—	958	43	1,017	44
Apr.–June ...	—	—	—	—	—	—	979	40	958	39
July–Sept. ...	—	—	—	—	—	—	990	44	917	42
Oct.–Dec. ..	—	—	—	—	—	—	905	43	904	44
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	20,196	16·4	22,123	18·0	17,448	14·2	18,995	15·4	25,936	21·3
Apr.–June ...	16,214	13·1	15,781	12·7	15,603	12·5	15,672	12·6	16,002	13·1
July–Sept. ...	13,709	11·0	13,616	10·9	13,807	11·0	13,587	10·8	14,209	11·6
Oct.–Dec. ...	16,630	13·3	17,422	13·9	16,095	12·8	16,159	12·8	16,628	13·5
	Marriages									
Jan.–Mar. ...	7,731	6·3	8,093	6·6	7,891	6·4	7,662	6·2	12,005	9·6
Apr.–June ...	9,451	7·7	9,363	7·5	9,428	7·6	9,960	8·0	12,971	10·4
July–Sept. ...	11,403	9·1	11,516	9·2	11,902	9·5	15,620	12·4	15,625	12·3
Oct.–Dec. ...	9,311	7·5	9,379	7·5	9,526	7·6	13,015	10·3	12,996	10·2
	Infant Mortality									
Jan.–Mar. ...	2,411	108	2,104	97	1,790	80	1,890	88	2,474	112
Apr.–June ...	1,677	71	1,733	73	1,563	65	1,442	61	1,568	67
July–Sept. ...	1,378	64	1,299	60	1,233	58	1,220	57	1,215	57
Oct.–Dec. ...	1,819	85	1,914	93	1,577	75	1,403	69	1,509	76

No. III.—NORTHERN IRELAND

BIRTHS, DEATHS, *and* MARRIAGES : *Numbers and Annual Rates per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1936–1940 and in the Quarters of those years.*

Years	1936		1937		1938		1939		1940	
Estimated Mid-Year Popln. in thousands	1,276		1,281		1,296		1,295		1,296	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births	25,909	20·3	25,412	19·8	25,743	20·0	25,240	19·5	25,385	19·6
Stillbirths				Not separately recorded						
Deaths	18,429	14·4	19,282	15·1	17,640	13·7	17,512	13·5	18,041	14·6
Marriages	9,144	7·17	8,623	6·73	8,617	6·70	9,185	7·09	9,600	7·41
Infant Mortality	1,992	77	1,969	77	1,933	75	1,779	70	2,174	86
Quarters				Live Births in the Quarters of each Calendar Year						
Jan.-Mar.	6,448	20·2	6,308	19·7	6,296	19·6	6,234	19·3	6,167	20·0
Apr.-June	6,793	21·3	6,917	21·6	6,902	21·5	6,859	21·2	7,094	21·9
July-Sept.	6,612	20·7	6,444	20·1	6,515	20·3	6,340	19·6	6,334	19·5
Oct.-Dec.	6,056	19·0	5,743	17·9	6,010	18·8	5,821	18·0	5,490	16·9
				Deaths (excluding Stillbirths)						
Jan.-Mar.	5,375	18·4	6,796	21·2	5,153	16·0	5,350	16·5	6,597	20·4
Apr.-June	4,481	14·0	4,511	14·1	1,283	13·3	4,371	13·5	4,594	14·2
July-Sept.	3,358	11·2	3,605	11·3	3,799	11·8	3,686	11·4	3,759	11·6
Oct.-Dec.	4,512	14·1	4,369	13·6	4,116	13·7	4,112	12·8	3,991	12·3
				Marriages						
Jan.-Mar.	1,725	5·4	1,790	5·6	1,599	5·0	1,132	4·4	2,104	6·5
Apr.-June	2,454	7·7	1,913	6·0	2,229	6·9	2,209	6·8	1,979	6·1
July-Sept.	2,763	8·7	2,688	8·3	2,602	8·1	2,559	7·9	2,976	9·2
Oct.-Dec.	2,202	6·9	2,232	6·6	2,157	6·7	2,637	8·1	2,541	7·8
				Infant Mortality						
Jan.-Mar.	622	96	616	98	668	106	599	96	689	107
Apr.-June	480	71	496	72	455	66	418	65	801	85
July-Sept.	401	61	370	57	368	56	316	55	181	76
Oct.-Dec.	487	80	482	84	436	72	381	67	103	73

No. IV.—ÉIRE

Births, Deaths, and Marriages: *Numbers and Annual Rate per 1,000 persons living. Deaths under 1 year of age: Mortality per 1,000 Live Births in the Calendar Years 1936–1940 and in the Quarters of those years.*

Years	1936		1937		1938		1939		1940	
Estimated Mid-Year Popln. in thousands	2,967		2,948		2,937		2,934		2,958	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	58,115	19·6	56,188	19·2	56,025	19·4	56,070	19·1	56,510	19·1
Stillbirths ...					Not separately recorded					
Deaths	42,586	14·4	45,086	15·3	40,041	13·6	41,717	14·2	42,033	14·2
Marriages ...	11,763	5·0	14,780	5·0	14,893	5·1	15,201	5·2	15,323	5·2
Infant Mortality	4,309	74	4,121	73	3,794	67	3,891	66	3,698	65
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	14,434	19·5	13,554	18·4	14,083	19·2	14,215	19·4	14,110	19·1
Apr.–June ...	15,100	20·4	15,052	20·4	14,697	20·0	14,475	19·7	15,073	20·4
July–Sept. ...	14,917	20·1	15,008	20·4	14,768	20·1	14,262	19·4	14,358	19·4
Oct.–Dec. ...	13,664	18·4	12,574	17·5	13,377	18·2	13,088	17·8	12,969	17·5
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	12,873	17·4	15,360	20·8	11,412	15·6	13,313	18·1	13,376	77
Apr.–June ...	10,821	14·6	11,206	15·2	9,844	13·4	10,872	14·1	10,506	62
July–Sept. ...	8,652	11·7	8,617	11·7	8,587	11·7	8,600	11·7	8,530	50
Oct.–Dec. ...	10,240	13·8	9,903	13·5	10,198	13·9	9,432	12·9	9,621	73
	Marriages									
Jan.–Mar. ...	3,796	5·1	3,303	4·5	3,824	5·2	3,487	4·8	3,509	4·7
Apr.–June ...	3,427	4·6	3,717	5·0	3,435	4·7	3,665	5·0	3,851	5·2
July–Sept. ...	4,183	5·6	4,202	5·7	4,379	6·0	4,511	6·2	4,612	6·2
Oct.–Dec. ...	3,357	4·5	3,558	4·8	3,255	4·4	3,538	4·8	3,551	4·5
	Infant Mortality									
Jan.–Mar. ...	1,231	85	1,260	91	1,155	81	1,173	82	1,085	77
Apr.–June ...	1,026	68	1,095	71	946	64	932	64	938	62
July–Sept. ...	893	60	863	57	810	55	754	53	723	50
Oct.–Dec. ...	1,156	85	903	69	883	66	832	64	952	73

No. V.—GREAT BRITAIN AND IRELAND

SUMMARY OF BIRTHS, DEATHS, AND MARRIAGES *in the years* 1937–1940: *Numbers and Rates per* 1,000 *persons living. Deaths under* 1 *year of age: Mortality per* 1,000 *Live Births.*

(Compiled from the Quarterly Returns of the respective Registrars-General.)

	England and Wales	Scotland	Northern Ireland	United Kingdom	Éire
Area in statute acres (thousands)	37,340	9,462	3,488	50,290	17,254
1937					
Population (in thousands) ...	*41,031*	*4,977*	*1,281*	*47,289*	*2,948*
Births	610,557	87,810	25,412	723,779	56,488
Birth rates·	14·9	17·6	19·8	15·3	19·2
Deaths	509,574	68,942	19,282	597,798	45,086
Death rates	12·4	13·9	15·1	12·6	15·3
Marriages	359,160	38,334	8,623	406,117	14,780
Marriage rates	8·8	7·7	6·7	8·6	5·0
Deaths under 1 year ...	34,917	7,050	1,969	43,931	4,121
Infant Mortality rates ...	58	80	77	61	73
1938					
Population (in thousands) ...	*41,215*	*4,993*	*1,286*	*47,494*	*2,937*
Births	621,204	88,627	25,742	735,573	56,925
Birth rates	15·1	17·7	20·0	15·5	19·4
Deaths	478,829	62,953	17,649	559,431 ·	40,041
Death rates	11·6	12·6	13·7	11·8	13·6
Marriages	361,768	38,716	8,617	409,132	14,893
Marriage rates	8·8	7·8	6·7	8·6	5·1
Deaths under 1 year ...	32,473	6,163	1,933	40,569	3,791
Infant Mortality rates ...	53	70	75	55	67
1939					
Population (in thousands) ...	*41,460*	*5,006*	*1,295*	*47,739*	*2,934*
Births	619,352	86,899	25,240	732,410	56,070
Birth rates	14·9	17·4	19·5	15·4	19·1
Deaths	498,968	64,413	17,512	581,154	41,717
Death rates	12·1	12·9	13·5	12·2	14·2
Marriages	439,691	46,257	9,185	492,500	15,204
Marriage rates	10·6	9·2	7·1	10·1	5·2
Deaths under 1 year ...	30,927	5,955	1,779	38,059	3,691
Infant Mortality rates ...	50	69	70	53	66
1910					
Population (in thousands) ...	*41,460*	*5,030*	*1,296*	*47,786*	*2,958*
Births	607,131	86,103	25,385	718,019	56,510
Birth rates	14·6	17·1	19·6	15·0	19·1
Deaths	572,882	72,775	18,941	664,598	42,033
Death rates	13·8	14·9	14·6	13·9	14·2
Marriages	468,267	53,597	9,600	531,466	15,323
Marriage rates	11·3	10·6	7·4	11·1	5·2
Deaths under 1 year ...	33,638	6,766	2,171	42,578	3,698
Infant Mortality rates ...	55	78	86	59	65

ERRATUM.

The equation on p. 160, 6 lines from bottom, and in the heading of the 3rd col., Table 11, p. 161, should read $y = e^{\cdot 00552 + 3 \cdot 519}$.

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FACTORY INSPECTION : A THIRTY-FIVE YEARS RETROSPECT

By SIR DUNCAN WILSON, C.V.O., C.B.E.

[Read before THE ROYAL STATISTICAL SOCIETY on May 20th, 1941,
The PRESIDENT, MR. H. LEAK, in the Chair.]

THE author feels it incumbent on him to preface the following paper
with an explanation and even an apology.   War-time circumstances
have prevented access to many of the records that would be necessary
to give anything like a complete picture of the subject under dis-
cussion, with the consequence that he has had to rely largely on his
own memories and impressions, and to content himself with sub-
mitting what is frankly little more than a disjointed set of facts,
arising principally from his own experience.   Their sole claim to
interest, in short, lies in the fact that a great crisis like the war
tends to obliterate memory of events immediately preceding it,
and a record—however rough and narrow—of these is sometimes
worth preserving.

The main object of the present paper is to compare the con-
ditions—both internal and external—of the Factory Inspectorate
of Great Britain in 1904, when the writer joined the Department,
with those in 1939,* at the end of which year he retired, but some
reference to still earlier days is perhaps admissible.

The Factory Inspectorate is one of the oldest executive depart-
ments of State.   The first inspectors—four in number—were
appointed with a tiny staff of assistants in 1833, in pursuance of
an Act passed in 1832, and it is perhaps worth recording that the
centenary of the Inspectorate was celebrated in 1933 by a public
dinner, which was attended by their Royal Highnesses the Prince
of Wales and the Duke of Kent, and by the Secretary of State
for Home Affairs (the late Sir John Gilmour) and four of his pre-
decessors in office.

* Since 1939 was not a normal year owing to the outbreak of war, the year
1938 has been substituted in some of the comparisons that follow.

A quotation from *The Times* of 1833 is suggestive of the conditions existing at that time. It has nothing to do with factories; it relates to the famous danseuse Taglioni. The sentence (trivial enough in itself) reads :—

> " An unmerciful part of the audience with more than factory cruelty insisted on an encore."

We all know that unmerciful part of the audience only too well; the significant point is that the very word " factory " must then have been in vernacular use as connoting oppression and slave-driving.

Of the four original inspectors—Horner, Howell, Richards and Saunders—the records of three survive only in the voluminous Reports, which—unhappy men—they were required to submit every three months to the Home Secretary. Leonard Horner, however, who appears to have been *primus inter pares,* is known to have been a remarkable man. Born in 1782, he was originally a silk merchant in Edinburgh, but soon devoted himself to scientific and educational work. He took special interest in geology, early becoming a Fellow of the Geological Society and being elected subsequently to a Fellowship of the Royal Society. In 1821 he founded what must have been the earliest technical college in existence, The Edinburgh School of Arts for Working Men, at which about 400 students were instructed in printing, brass-founding and watchmaking. In 1826 he was appointed the first warden of the new University of London, but—as has happened not infrequently in more recent times—he had " trouble " with the Professors, who " showed every disregard of his instructions," and in 1830 he resigned to take up investigatory duties for a Commission enquiring into the conditions of employment of Children in Factories. This work led directly to his appointment as one of the four original inspectors of factories.

Such is all that is traceable as to the previous history of the four inspectors, but their reports show that they were all exceptional men, well chosen for their duties. Wisely enough, they relied for the successful discharge of their duties on the education and persuasion of the employers of that day rather than on the full exercise of the autocratic powers conferred on them by statute, and their periodical reports to the Home Secretary are devoted to appreciation of the growing tendency of employers to accept the expediency of more humanitarian methods, just as much as to the castigation of recalcitrants, though for many years each offender prosecuted was pilloried by name (presumably *pour encourager les autres*) with a detailed description of his offence.

Incidentally, the lives of these inspectors were not altogether easy. As early as 1836, the Home Secretary was informed in one letter of the misfortunes of two of their staff :—

> (i) Mr. Trimmer was last month mobbed by factory people in a country situation near Oldham, and
> (ii) Mr. Bates broke his leg last month in the service (whether in the same circumstances or not is not divulged).

Thus were the foundations of the Inspectorate well and truly laid, and even with the huge expansion of staff from four to over 300, the example set by this little group has been followed ever since.

And now to come to more recent times— the earlier part of the present century when the writer joined the service. A few years before, the big consolidating Act of 1901 had been passed and this had caused considerable expansion in the size of the Inspectorate. Among the new entrants were many inspectors, now mostly retired, who subsequently did exceptionally fine work and helped to raise the status of the Department to its present high level. It is obviously no reflection on them to say that compared with to-day, procedure was distinctly casual. A candidate after receiving a nomination from the Home Secretary underwent a competitive examination— for the most part very elementary in character— and after about a fortnight's training under a senior inspector was assumed to be capable of carrying out his duties alone. To anyone like myself who was unfamiliar with factory conditions, this experience was often embarrassing at first, and one had to be careful to avoid glaring mistakes, such as that of a young colleague who drafted a letter— fortunately never sent— pointing out that a certificate of examination for the boiler of a gas-engine (a type of prime mover just coming into vogue) had not been obtained. The writer personally discovered- after a few false starts- that the most successful method was frankly to admit his ignorance before it became discovered, and to ask for instruction from, say, the works engineer- who then, as now, was always willing to devote much time and trouble to explaining technical details of production, a method which in course of time afforded a fairly good knowledge of the principal industries. Not that all was plain sailing, for many employers were still definitely hostile to inspection.

Time-cribbing was very common, especially in textile mills in the North, where the dodge was to try to run the plant for two or three minutes beyond the legal period. This called for very active work for its detection, especially since, by a system of telephonic communication, the inspector's presence in a given town was

quickly known--surprise entries with a watch specially timed, the taking of names and addresses of a large number of workers, and, generally speaking, making oneself an unmitigated nuisance. It is fair to say, however, that as a rule the mill-owners bore no grudge against the Inspector, and that in the North at least the practice was strongly deprecated by most of the local Benches, who often inflicted heavy fines for these breaches of the Act.

Similarly, another class of offence now virtually unknown, consisted in breaches of the Truck Acts, workers being compelled to buy their goods from "tommy" shops kept by the employers, and being fined quite unreasonable amounts for spoilt work. Remarkable work in putting down these abuses was done by the small nucleus of "lady" inspectors—as they were then called—who had been first appointed in 1893 by Mr. H. H. Asquith when Home Secretary.

Safeguarding of machinery was still very imperfect, and had little of the scientific character which it now possesses. Fencing of dangerous machinery was often of the Heath Robinson type, and severe accidents were frequent.

The fight against industrial diseases, too, had only just begun through the appointment of the first medical inspector in 1898. The chief known scourges were lead poisoning, anthrax and phosphorus necrosis, though it is pertinent to point out that conditions now established as industrial diseases—in particular silicosis and asbestosis—were not recognized as such until much later, and that their present prevalence is due to this ignorance as much as to the harmfulness of exposure to the conditions causing them.

The staff at the beginning of the twentieth century numbered about 150, nearly all men (under Sir Arthur Whitelegge as Chief Inspector), with a small group of independent "lady" inspectors, headed by Dame Adelaide Anderson, one Superintending Inspector for Dangerous Trades and Machinery (Sir Hamilton Freer-Smith), one Medical Inspector (Sir Thomas Legge), and one Electrical Inspector (Mr. G. Scott Ram), then just appointed on account of the large number of accidents consequent on the growing use of electrical power.

A rough picture of the changes that have occurred since then is given in the comparative table on page 213.

Owing to various administrative changes, the figures are not strictly comparable, in particular :—

(1) In 1904 Ireland was included in the field of inspection, in 1938 the field was confined to Great Britain. (This discrepancy, however, is not serious.)

Administration of the Factory Acts (1904 *and* 1938)

	1904	1938
Authorized Staff (Inspectors)	152	307
Expenditure	£72,965	£217,169
Places under Inspection :		
Factories	104,472	171,825
Workshops	145,278	67,785
Other	7,380	15,867 *
Total	257,130	255,477
Number employed in manufacturing industries		
(thousands)	4,124	5,610
Prosecutions (charges)	3,009	1,479
Reported Accidents :		
Fatal	1,018	944
Total	92,968	180,103
Fatal accidents per 100,000 employed	17·6	11·2
Cases of Poisoning :		
Diseases notifiable in 1904	656	113
Diseases notifiable since 1904	—	315
Visitors to Home Office Industrial Museum ...	—	15,200

* Not including 27,268 firms registered under the Lead Paint Act (1926).

(2) The statutory standards of reportability of non-fatal accidents differ. In 1904 the condition was that the victim should have been prevented on any one of the three succeeding days from being employed for five hours on his ordinary work; in 1938 that he should have been disabled for more than three days from earning full wages at the work on which he was employed.*

(3) The previous distinction between " factories " and " workshops " was abolished by the Factories Act, 1937 ; a nearly correct comparison can, however, be obtained for 1938, by taking factories with mechanical power as equivalent to " factories " in the older sense, and factories without mechanical power as equivalent to workshops.

In spite of these discrepancies, some interesting points emerge from the table :- -

(1) The staff of the Inspectorate has more than doubled. This bare statement, however, does not indicate the important developments that have occurred in internal organisation.

Firstly, the former so-called Lady Inspectors' Branch has gone,

* In making any historical comparison of factory accidents it is imperative to bear this point in mind. In addition to the two standards referred to, there was yet another, operative between 1907 and 1923, namely notification of accidents due to machinery and certain other causes resulting in one day's incapacity and all other accidents resulting in seven days' incapacity. Fatal accidents had of course always to be reported.

and women are now eligible for exactly the same duties as men; they constitute, in fact, about one-third of the staff.

Secondly, the former solitary representatives of the medical, electrical and safeguarding aspects of the work have expanded into whole groups of qualified inspectors; there are in fact now 13 medical inspectors, 11 electrical inspectors, and 17 engineering inspectors, concerned with engineering and chemical problems.

Another recent development has been the foundation of a permanent exhibition of plant and appliances connected with the safety, health, and welfare of industrial workers. Known as the Home Office Industrial Museum,* it is situated in Horseferry Road, but is at present temporarily closed.

Thirdly, the method of recruitment has entirely changed. In 1904 it was based solely on success at a competitive examination among candidates nominated by the Home Secretary, followed by two years of probation, at the end of which the appointment was confirmed almost automatically. (The writer, of course, was one thus favourably treated.) Now, when vacancies occur, notices are published inviting applications, and of the thousands received in response, a selection is made of those who from their records seem prima facie suitable for further consideration. These receive nominations and after undergoing a qualifying examination appear before a Selection Board of the Civil Service Commission, on whose recommendation they are appointed. They then serve for two years, at the end of which period they undergo a further qualifying examination dealing specially with Factory Act administration, a subject with which they are expected to have familiarised themselves during their probationary period. On their success in this examination, as well as on the reports received about their efficiency in inspection, they depend for continuance in the service.

Pari passu with the increase in staff the expenditure has more than trebled.

(2) The huge increase in the use of mechanical power is shown by the comparative figures for factories and workshops respectively. It will be seen that the number of factories has increased by about 70 per cent., whereas the number of workshops (which may be roughly defined as places without mechanical power) has been reduced to about one half.

(3) As already stated, the crude figures for the non-fatal accidents are not comparable, owing to the different standards of reporting. It may, however, be pointed out that owing to the

* The Inspectorate having been transferred in 1940 from the Home Office to the Ministry of Labour and National Service, this title will presumably be changed in the future.

criterion in 1904 (roughly one day's incapacity) being more stringent than in 1938 (three days' incapacity), the difference in the two situations is much greater than would appear from the actual figures. In other words, these accidents have greatly increased in more recent times. This is probably due partly to the more complete mechanization of industries, though the larger number employed in industry, together with a more complete fulfilment of legal obligations as to reporting also play a part.

On the other hand, the diminution in the number of fatal accidents per 100,000 employed, which may be regarded as a measure of the severe accident risk, may be noted.

(4) The data show that industrial diseases have been fought with far greater success than accidents. The cases of lead poisoning in 1938, for instance, were less than one-eighth of those in 1904.

(5) More willing compliance is indicated by the decrease in the number of prosecutions in spite of a more rigid standard of inspection.

Reference may now be made to a few points of interest that have emerged during the last few years.

(a) *Frequency of occurrence of factories according to size.*

Since 1930, triennial returns have been prepared of factories according to the number of workers employed. The results are summarized in the following table :—

Factories employing	Per cent. of total employment		
	1930	1933	1936
Up to 25 persons	13·0	14·0	12·8
,, 50 ,, ...	21·4	22·7	20·9
,, 100 ,, ...	32·9	31·8	32·2
,, 250 ,, ...	54·4	56·4	52·7
,, 500 ,, ...	71·0	73·3	68·7
,, 1000 ,, ...	83·7	86·2	81·2
(More than 1000	*16·3*	*13 8*	*18·8)*
All factories	100·0	100 0	100·0

It will be seen that although of late years the proportion of very large factories has increased, about one-third of the working population is accommodated in factories employing not more than 100 workers, and more than one-half in factories employing not more than 250 workers—in other words, most of the production in this country is, or was until recently, carried on in small and medium-sized establishments, though it is probable that owing to war developments this statement no longer holds good.

(b) In recent years an attempt has been made to make increased

use of the many thousands of accidents reported to the Inspectorate in two ways. Analysis of the accidents due to special causes has enabled danger-points to be indicated with precision and appropriate preventive action to be taken. At the same time, certain facts have emerged through the historical study of these accidents as a whole; in particular, the variations in accident rate, determined through a comparison of the total accidents with the numbers in employment.

One hardly creditable fact that emerges year after year is that, in proportion to their numbers, young workers under eighteen incur more accidents than adult workers of the same sex, even though it is probable (as shown by the opposite tendency in the case of fatal accidents) that their accidents are on the whole less severe and also that they are perhaps more ready to absent themselves from work. The following table shows the position :—

Accident Rates in Different Years

(*Manufacturing Industries*)

Year	Accidents per 100,000 employed								
	All accidents				Fatal accidents				
	Males		Females		All workers	Males		Females		All workers
	Young workers	Adults	Young workers	Adults		Young workers	Adults	Young workers	Adults	
1901*	2840	2270	580	380	1760	24	26	2	1	18·5
1904*	3030	2570	610	340	1940	18	26	3	0	17·6
1928	4440	3640	1351	869	2779	11	22	2	1	13·5
1930	4585	3510	1368	799	2420	13	21	2	1	12·4
1933	3720	2930	1320	817	2270	11	18	2	1	11·2
1935	4344	3404	1362	973	2660	10	19	2	1	11·0
1936	5100	3702	1569	1032	2930	10	20	1	1	12·2

* The total accident rates for 1901 and 1904 are comparable *inter se* but not with subsequent years.

There are, however, encouraging signs. In particular the latest Annual Report of the Chief Inspector (for 1939) states that in spite of the general increase of accidents during that year, there has been a decrease of 2 per cent. (696 accidents) in accidents to workers under eighteen.

A second matter that has received attention is the vital question whether accident risk is increasing or declining. Obviously, the total annual number of accidents is no criterion of this risk, since it must be influenced mainly by the number of persons in employment.

Sixteen years were available for this purpose, and in the following figure are plotted the annual number of accidents in manufacturing industries,* together with index figures representing the number employed. (All data are in the form of percentages, those for 1924 being taken as 100.)

Statistical treatment of the data (kindly undertaken by Dr.
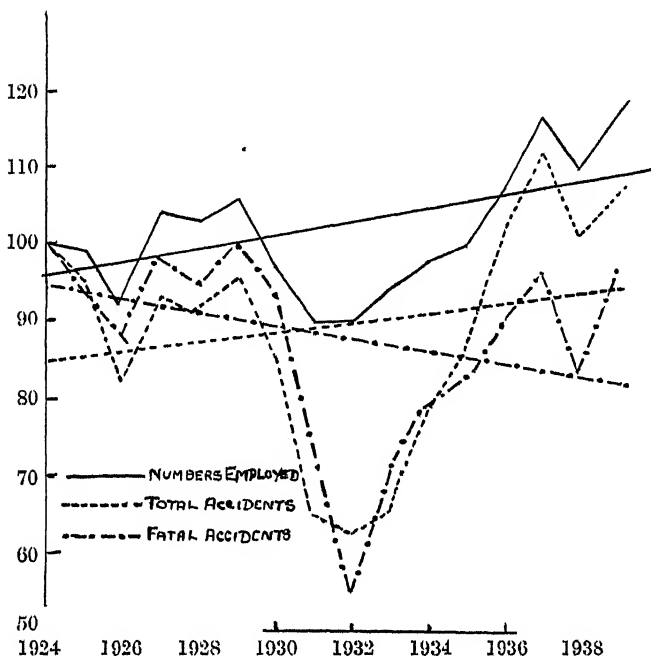

FIG. 1.

J. O. Irwin) has evolved the regression lines as shown. These are interesting, showing as they do that over the period explored, a distinct tendency for the numbers employed to rise has been associated with a smaller tendency for accidents generally to rise and with a tendency for fatal and presumably other severe accidents actually to fall.

The figure also discloses another factor in accident incidence. The fluctuations of the two curves, while similar, are by no means

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* About 10 per cent. of the accidents reportable to the Inspectors (and about one-third of the fatal accidents) occur on premises other than factories which are nevertheless subject to certain provisions of the Factories Act. These include buildings under construction, docks, and civil engineering works in all of which the risk of serious accident is higher than in factories generally. Owing, however, to the special nature of the work in these places and the impossibility of obtaining reliable figures as to numbers employed, these have perforce to be left out of account.

parallel, an increase or decrease in numbers employed being accompanied by a much greater increase or decrease in accidents, showing that factors other than the number of persons at risk are involved. This is more clearly shown in the following figure, in which numbers employed are compared with numbers of accidents per person employed. If individual risk of accident were a constant factor (the number of accidents depending solely on the number of persons at risk), the lower curve would be a straight horizontal line. Instead, the two curves are roughly parallel, showing that variations in numbers employed are positively associated with similar varia-
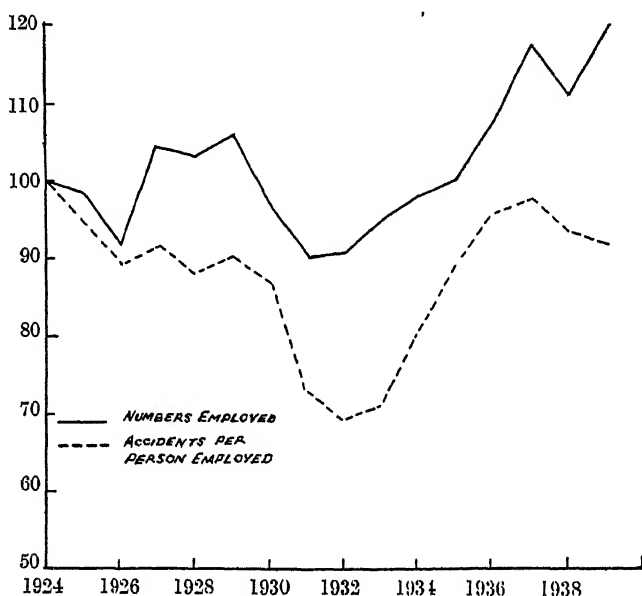

FIG. 2.

tions not only in mere numbers of accidents, but also with the risk of incurring them.

Some of the causes of this association are obvious. In times of prosperity, not only are more workers employed, but longer hours of work and more intensive production occur, more inexperienced young workers and workers out of practice are absorbed, and new machinery with unknown risks installed; conversely, in times of depression working hours are shortened, production is slowed down, and probably the more accident-prone section of the working population is first discharged leaving a more stable residue.

It will be seen that the year 1939 is exceptional, in that a large

increase in employment is associated with an actually lower accident rate.   The reason for this must await elucidation from later years' comparison (the employment data for 1940 are at present confidential).   Is it possible that the more stringent safety requirements of the Factories Act (1937), which came into force on 1st July, 1938, are showing their effect ?

Allusion may now be made briefly to some of the more striking changes that have occurred in industrial practice within the writer's remembrance.

First, as to the source of power.   In 1904 the commonest source of power was the reciprocating steam engine, and wonderful machines they were; in Worcestershire, for instance, there is a beam engine still working after continuous use for nearly 100 years.   Water-wheels and windmills also were quite common, while the latest and most fashionable prime mover was then the gas engine, which was being installed in the smaller works in increasing numbers.   To-day, while it is doubtless true that in the majority of factories steam continues to be the source of power, there is an increasing tendency to replace this by electric power, especially for sectional and unit drives, the need for shafting being thus dispensed with.   This tendency is being greatly helped by the extension of electrical facilities to all parts of the country through the " grid " system and the availability of low wattage electric motors, suitable for use in even the smallest places.   Not that the old forms of power have entirely gone, and it was only a few years since in Scotland the writer saw still working what is said to be the largest working water wheel in the world—a monster of 70 feet diameter.

For another contrast let us take artificial lighting.   In many parts, especially in the North, coal-gas with the open flame was the usual agent—in country districts even oil lamps were in frequent use since the electric filament and incandescent mantle, as they were then constructed, were unable to withstand the vibration to which they were exposed.   To-day open-flame gas-lighting is practically unknown, and the newer types, such as high-pressure gas, gas-filled electric units, daylight lamps, and within the last few years electric discharge lamps, are now almost universal.

There have also, of course, been enormous changes in methods of production, though it is interesting to note that owing to the genius of Arkwright, Hargreaves and others the textile trades were in 1904 already highly mechanized, and that since then methods have changed comparatively little.   Spinning, indeed—a marvel of ingenuity—remains virtually where it was, while in weaving the only real innovation has been the introduction and extending use of the automatic loom, in spite of many inventions designed to

revolutionize the method *in toto*. On the other hand, chains and files, to take two simple examples, now almost all produced mechanically, were then mostly made by hand in small workshops, generally in the back-yards of cottages. Matches, again, are another instance. The writer can remember visiting in 1906 all the match factories in the United Kingdom—about 20 in all. In these every matchstick was fixed by hand in a special frame, the heads then dipped in a special composition, and the finished matches packed by girls into boxes by hand. Incidentally, so dexterous did these girls become that they could pick up a handful of matches not differing by more than one or two from the requisite number. Hand production has now entirely gone, and matches are now made and packed on almost completely automatic machines.

Another industry that has been revolutionized is motor-car manufacture. In 1904 cars were few and very expensive, besides showing an inveterate tendency to break-down. They were then assembled individually piece by piece. Nowadays they are (or were till lately) turned out by thousands, generally by mass production—that is to say, the successive operations are done by a series of workers as the car moves slowly down the shop. Within recent years even the bodies have been constructed on this system, so that it is no exaggeration to say that most modern cars begin their life of movement from the time they start from nothing till they emerge as the finished article.

Other notable examples of the substitution of mechanical for hand processes occur in riveting, charging of furnaces, and paint spraying.

But, in spite of these widespread changes, it is wrong to say (as is sometimes alleged or implied) that old-time craftmanship has disappeared. Glass-blowing, for instance, is still carried on on an extensive scale, and the making of a wine-glass or of glass tubing, in which the tools are of the simplest character, remains a wonderful example of dexterity and judgment. The manufacture of certain kinds of pottery, too, still involves much manual skill as well as artistry, and some years ago the writer discovered a small workshop in which racing stirrups were forged entirely by hand.

But perhaps the most striking difference between the two years is in the nature of the products manufactured, and especially in the way that new inventions or developments have eliminated or reduced previously existing industries. The vast increase in motor-car and motor-lorries has largely killed the harness trade formerly carried on in Walsall, and the huge flour-mills installed in most of our sea ports have replaced the old country wind- and water-mills. The cinematograph industry, unknown in 1904, has grown to large

dimensions, and until recently was still developing; artificial silk, produced from wood pulp or cotton waste, has made silk stockings available to all, while the manufacture of aeroplanes and their parts was even before the war becoming one of the most important industries in the country. And many other similar instances could, of course, be given.

One other development may be noted. To many persons the word " factory " suggests big, or even huge, establishments in which production is virtually self-contained, the numerous articles required and the accessories for making them being manufactured without external aid. There has, of course, been a notable increase in these in recent years. The writer, however, is inclined to suggest that there have been certain tendencies in the opposite (or at least different) direction—namely, first, owing to better transport facilities, an increase in the manufacture of components to be used in other factories, and, secondly, an increase in the number of small- or medium-sized factories concentrating on the manufacture of special articles of uniform type, owing in part to facilities offered by the various trading estates in the country. As an example of the first, there are factories in which motor-car bodies or radiators—useless in themselves—alone are made, and then transported to the actual motor-car works for the production of the finished article; similarly many large works have their castings and forgings made by outside firms. As examples of the second point, the writer need only say that within recent years he has seen one factory devoted wholly to the making of semi-rotary blotters, and another engaged exclusively in the manufacture of Jew's harps.

At all events, as has been already pointed out, it is quite wrong to suppose that our supply of manufactured articles depends entirely—or even mainly—on big factories.

Let me now turn to the more personal aspects of industry. One of the most striking developments of modern times has been the formation of large combines, replacing 'or absorbing the small employer. This loss of paternalism, and of the times when the boss used to know all his workers and call them Jack, Bill and so on, is sometimes deplored as a misfortune. I do not agree with this view for a moment. It is true that many considerate and kindly employers then existed, but there were many, and probably the most, whose first object was profit, and last object was the safety, health and general interests of their workers.

I can illustrate this from my own experience. When I was a young man, factory inspectors were generally treated not only as inspectors of nuisances, but as nuisances themselves. Any advice or instruction was grudgingly received, often with some comment

about " wrapping the workers up in cotton wool," and I can still remember one morning when, having become slightly bored by hearing this remark about five times, I told one manager that if he wanted to be really offensive, he had better be a little more original. To-day factory inspectors are nearly always regarded as friends able and willing to help, and many employers are ready to go beyond their legal obligations in the interests of their workers. I am quite convinced that never before have the comfort and welfare of the workers received more consideration, especially in modern factories, where the necessary facilities can be arranged in planning the buildings.

A no less striking difference is to be seen in the workers themselves. In 1905 the writer had to visit many cotton mills at 6 a.m. From 5.30 to 6 a.m. one used to hear the loud clatter of clogs on the cobbles and see a crowd of " mill hands," as they were then called, all dressed alike, with heavy shawls over their heads, walking—generally in the rain—to their work in the mills. In 1938, the streets at that hour were silent, and it was not until about 8 a.m that one saw a well-dressed crowd starting for their day's work.

A similar change is noticeable everywhere. The bedraggled, ill-mannered and ill-spoken worker has gone, and been replaced by one with self-respect, good appearance and, as I think, with the best manners of any social class.

But there is one aspect of industry in which we have progressed but little—and that is accident incidence. While the former health risks, such as lead poisoning, " phossy jaw " and anthrax, have been almost or quite eliminated, accident risk seems to have been little affected by all the attention and skill that has been devoted to its study. There are, indeed, indications that, owing to higher standards in safeguarding machinery, the general severity of accidents has diminished in recent years, and it may be hoped that the recent Factories Act of 1937, catering as it does for the prevention of accidents due to causes other than machinery, will eventually result in a diminution of accidents of all kinds.

Another notable development of recent years has been the number of organizations formed for the study of the human side of industry from different aspects. I refer in particular to the Industrial Health Research Board of the Medical Research Council (founded in 1917), the Royal Society for the Prevention of Accidents, formerly the National Safety First Association (founded in 1921), the National Institute of Industrial Psychology (founded in 1923), the Industrial Welfare Society (founded in 1918) and the Institute of Labour Management (founded in 1913). All these have contributed to our knowledge of the subject, which proved to be of value in preparing

the latest piece of factory legislation—the Factories Act of 1937.

In conclusion, mention may be made of the work of the Factory Inspectorate itself. Successive legislation has imposed on the Department duties of a rather miscellaneous kind, ranging from the prevention of accidents and industrial diseases to the more simple task of ascertaining whether gas supplied to factories under certain Private Acts has " a distinctive and readily perceptible smell " (a responsibility of which I doubt whether many Inspectors are now aware). Between these two extremes, Inspectors have many important duties with regard to the hours of employment of women and young persons under 18, welfare, and certain matters relating to wages—*i.e.*, the furnishing of prescribed particulars in the case of piece-work and the enforcement of the Truck Acts in factories.*

I have always maintained that the life of a Factory Inspector must be almost unique in the Civil Service for variety and interest. He has to hold his own with every type of employer and workman, and is continually confronted with unexpected situations. Incidentally, in the course of time he learns roughly how almost everything in use is made. This in itself is an education, which is never completed. Lastly, he retires with the consciousness that he has to the best of his ability done beneficent and constructive work. Mr. H. G. Wells in one of his most grandiloquent paragraphs says :—

> " If a cotton operative of 1831 could be taken over a Lancashire mill to-day, he would remark on the light, the clear atmosphere, the absence of little children, and the air of alertness, intelligence and self-respect that reigns among the workers. If he talked to this generation of his great-grandchildren, he would find independence in the place of hopelessness, social humour for his bitter class hatred, and technical interest in improvements for his blind agonised obstruction to every economy of toil."

That this is true of industry generally, few will deny. But it would be wrong, of course, to suggest that the difference between the outlook of the misguided appreciators of Taglioni (to which reference was made earlier) and that of the resuscitated cotton operative of Mr. Wells is due to the factory inspectorate alone. Public opinion is, and must always be, the most potent factor in progress, and the chief value of the work of the inspectorate throughout the last hundred years has been to bring laggards into line with an accepted

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* This description applies to their normal functions. Before and since the outbreak of war, many other emergency duties have been imposed on them.

standard, since this standard is never static, and the mere application of pressure to those who do not conform to it at any given time has proved effective in giving it a forward impetus.

It would also be both ungenerous and unjust to finish this review without tributes both to the employers and workers in this country for their parts in recent years in helping to secure a standard of factory conditions which was long in advance of, and is still equal to that of any other country. This object could never have been achieved by a small body of government officials alone, but only with the willing compliance, help and friendliness of those directly concerned with industry. The main function of the experienced Factory Inspector to-day is, in fact, instruction and advice, rather than compulsion.

DISCUSSION ON SIR DUNCAN WILSON'S PAPER

MR. A. W. GARRETT, H.M. Chief Inspector of Factories, in proposing a vote of thanks to his old chief, Sir Duncan Wilson, said that he himself joined the service just two years after the beginning of the period which the author had treated. The author had pointed out the poorness of the Inspectorate in the earlier years of the present century. That, however, was not quite his own impression. He could not agree that all the inspectors then appointed were ignorant of factory conditions. He had had the advantage of being taught by some of the famous engineers who were his immediate seniors, and five or ten years before that there was appointed to the staff, mainly through the influence of Mr. Asquith, a fine body of engineers who took up the work begun by those old inspectors and placed the guarding of machinery on a scientific basis. At about that same time the new lady factory inspectors were doing an excellent piece of work in connexion with the machinery used in trades in which women were chiefly employed, for example, the laundry and clothing trades. Therefore those ten years brought the safety side of the work for the first time on to really scientific lines.

Inspectors were always interested in accident statistics. He himself desired to see, if time allowed after the war, a real statistics of accidents established. Something was wanted which would demonstrate the accident figures not only against the total numbers employed but against the man-hours worked, because that was the real criterion. On reading the paper he had felt that the author was rather pessimistic on the question of accidents, though on listening to him that afternoon the feeling of pessimism was a little relieved. There were three points to be noted in this connexion—namely, (1) better reporting, (2) the diminution in the number of severe accidents, and (3) the change in the attitude of employers, particularly since the last war. The reporting was distinctly better

because it had become a routine matter in every department of the factory. The reporting of accidents was now closely concerned with the Workmen's Compensation Act, and the two things ran together. In the early days it was quite common to find accidents concealed by a certain type of employer because he was not properly insured.

With regard to the severity rate, this was hard to set down in exact figures on paper, but the experience of all old inspectors was that the number of severe accidents had considerably decreased. He would give one illustration. He had been concerned during the whole of his career with a large steel works in the Midlands, and the number employed there was very much the same now as it was when he first knew it. Thirty years ago that works had two fatal accidents a month on the average. There was even a ward in the local hospital which was known by the name of the factory because it was always full of factory cases. To-day that exclusive use of the ward was a thing of the past, and the works were very much disturbed if they got more than two fatal accidents a year.

The third point was the change in the attitude of the employers. If he had to put his finger on one great thing that had impressed him during his career it was that single fact. He had the advantage or disadvantage of coming back to factory inspection after four years away from it in the last war, and the change that he found— a change which had gone on developing ever since—in the attitude of the employers, particularly through the influence of the larger firms, had done more for the saving of life and the bettering of conditions than any other single factor.

One thing, however, that beat them in extending prevention was the fact that 75 per cent. of the accidents were not due to machinery at all. They were due to trips and falls and bangs and so forth, and until there were real statistics as to these they could not suggest a remedy. They could tackle the accidents due to machinery, but these other accidents were more difficult to deal with.

He turned next to the table which showed the number of factories in this country classified according to size. It would be seen from this table that 75 per cent. of the factories on the registers were employing under 25 people, although in aggregate they employed only 13 per cent. of the working population. The layman generally thought that anybody employed in a factory must be one of hundreds or thousands of employees. But in fact the chief work of the factory inspector lay in quite small factory units, and the trouble there was that often there was not the broad outlook which characterized the management in the larger concerns.

The next table showed the accident rates in different years in the manufacturing industries, and in connexion with that table the author, with his usual modesty, had failed to bring out that the improvement in respect of young workers and the steps taken to guard them were the sole result of the efforts of Sir Duncan Wilson, and he wished to assure him that, so far as he could see from the way in which things were going, the improvement was likely to be

progressive. He honestly believed they were getting down these terrible rates of accidents for young people to a permanently more reasonable level.

Finally, he thought that the author might have included a much bigger table of industrial diseases. He would give the meeting two figures. In 1900 the cases of lead poisoning numbered 1,058 and the deaths 38. In 1939 the numbers were respectively 109 cases and 6 deaths. In the case of white and red lead poisoning the number of 377 cases with 6 deaths was down to 10 cases only, and in the pottery trade from 210 cases with 8 deaths there had been a reduction to 7 cases only. In the white-lead trade they had learned to grind the white lead into oil without intermediate treatment, and in the potteries they had learned much concerning low-solubility glazes. Nevertheless, in spite of these technical improvements in the trades themselves, all credit must be given to the medical inspectors for the wonderful work they had done, not only in their own province, but in keeping the other inspectors right on the regulations, and also in teaching their own profession the danger of these industrial diseases and the necessity of keeping a sharp look-out for them. He would be the last person to say that they had gone as far in factory inspection as they yet might do, but it was good to look back and to see what had been accomplished. It stimulated both faith and optimism.

SIR JOHN FORBES WATSON, in seconding the vote of thanks, spoke in appreciative terms of the paper. His work as Director of the British Employers' Confederation had brought him into frequent touch with Sir Duncan and his department, more especially in connexion with the new Factories Act of 1937, which consolidated and brought up to date the factory law of this country. He could, from practical experience, testify to the importance of the work with which Sir Duncan was charged and the success with which he had performed it.

The importance to Great Britain of the factory inspectorate was self-evident. This country was the most highly industrialized in the whole world, and it was because of its ability to produce manufactured articles for export that it had been able, in this small island with a large population, to maintain the standard of life, and also to accumulate those foreign investments which at present were a very real asset to the nation. Before this war began the total number of the occupied population who found employment in agriculture was only 7 per cent., whereas even in Belgium it was 20 per cent., in the United States of America 23 per cent., in Germany 30 per cent., in France 40 per cent., in Japan and in Italy 55 per cent., and in Poland 75 per cent. Factory life, therefore, affected a higher proportion of the population than in any other country.

If, by neglecting factory inspection and factory conditions, we had allowed a low standard to prevail, a burden would have been placed on national health insurance. It would have been as shortsighted to have neglected the health of people in factories as to have neglected the price factor in respect of export goods, because it would have

put a drag upon unemployment social insurance. No one was prepared to say that factory inspection, even in this country, was perfect, or that the accidents which occurred were all non-preventable, but, as Sir Duncan had said, the standard of factory conditions here had been long in advance of those in any other country. Sir Duncan was perhaps too modest in his claim. For twenty years the speaker had had an intimate knowledge of factory conditions in the competing countries, and he was convinced that the factory conditions here were better than in any country in the world, thanks very largely to the efficiency, vigilance, and understanding of the factory inspectors.

Sir Duncan had said that he was equally convinced that never before had the welfare of the worker received such consideration, especially in modern factories, where the necessary facilities could be arranged in planning the buildings. That testimony should be a source of pride. But he desired to take up what the previous speaker had said as to how that position had been reached. Sir Duncan had stated that it had not been achieved by a small body of Government officials alone, but only with the willing compliance, help, and friendliness of those directly concerned in industry. He himself could say without fear of contradiction that the spirit in which the Factory Department had in his time administered factory affairs furnished the explanation. He made open confession that when he first came in touch with the factory inspectorate an impression still lingered here and there that the factory inspector was more of an inquisitor than a friend. But that spirit had changed, and the change was largely due to the fact that during the last twenty years the Factory Department had been so ready to consult the employers and the workers in drawing up their regulations. After all, in this democratic country of ours an Act of Parliament was a poor substitute for goodwill, and in these consultations there had been achieved that goodwill which counted for so much. It was perhaps not generally known, but it was recorded in Hansard, that the 1937 Act was on the stocks as a draft Bill for some five or six years, and during that time the British Employers' Confederation and the Trade Union Congress discussed every clause and aspect of the Bill with the officials of the Factory Department, with the result that when the Bill came before Parliament it was more or less an agreed measure. Obviously, a piece of legislation drawn up in that way was much more likely to achieve its results than one which was thrust upon the parties without practical consideration of circumstances.

The Factory Department had to hold the scales between ideals on the one hand and practical considerations on the other, and he was pleased to have this opportunity of saying how much the employers of the country appreciated the understanding manner in which the Factory Department had acted, although the employers had not always by any means had their own way.

In conclusion, there was one aspect of the matter to which Sir Duncan referred but did not develop—namely, the analysis of factory conditions in this country as compared with others. Some might say that this was now a matter of academic interest, for no

one knew what the frontiers of Europe were going to be after this war had been won. But when the war was won this country would require to export its goods to maintain its population of 46 million at the standard of life to which they had been accustomed, and it would have to produce its goods and sell them at prices which would be in competition with the goods of other countries. The prices in those other countries would depend on their standards of living. That point had been much in his mind during the twenty years he had represented the British employers at the Conferences of the International Labour Office at Geneva. He was afraid he was not very popular there, but he had the satisfaction of knowing that he was permitted to represent his country at Geneva longer than any other person. He was sometimes critical when, instead of fixing minimum conditions, they tried to pass conventions fixing maximum ones. This organization was set up in order to bring about uniform minimum conditions of labour throughout the countries of the world, and he sometimes asked himself whether the countries voting for the conventions really wanted to carry them out, or, if they did want to carry them out, whether they were able to do so. The economy of some of these countries was inadequate for such provision. He recorded his vote with regard to many conventions at Geneva, but never in regard to any unless he was satisfied that his country could honour it and carry it out. There was a committee each year which looked into what had happened to the previous conventions, which countries had ratified them and so on, but the only matter of concern seemed to be whether the country had passed a law on the subject—sometimes it had not done so—but the question of whether the law had been carried out seemed to be disregarded. The important matter was not the passage of the law, but the setting up of factory inspection sufficiently vigilant and powerful to secure results.

The question of factory inspection was raised in the quite early days of the International Labour Office—he thought in 1923. No convention was passed, only a recommendation, which had much the same force as a resolution. But the discussion revealed a distinct cleavage of conception between continental countries and our own. In continental countries the principle with regard to factory inspection was that if a man was accused he was guilty until he had proved himself innocent; in this country he was innocent until he was proved guilty. The result, as in so many of these matters, was a compromise.

He had always thought that something should have been done to give this country a picture showing how far it was in advance of other countries, in order that measures might be taken to bring those others up to the British standard in the interests of humanity, and also in the interests of Great Britain's export trade. He did not stop there; he made it his business to investigate the factory inspectors' reports from various countries, and he found that many countries issued no reports at all, while some had issued no report for a number of years. If he now claimed that Great Britain was in the front rank with regard to this matter, it was because he had gone into the subject and examined it from every point of view. In one respect it

might appear that we were at a disadvantage as compared with other countries—namely, in the relatively small number of inspectors. But that was because in some countries the factory inspectorate consisted of the whole of the police force ! That was an illustration of the pitfalls in the comparison of international statistics. Countries, in fact, differed in respect of their laws, the interpretation of them, and the public opinion by which they were effectively enforced.

He hoped to attend another meeting of the Royal Statistical Society when Sir Duncan would provide them with a further paper on the comparative conditions of different competing countries. There was no one who could tackle the subject better, for before his recent retirement he was in intimate touch with his " opposite numbers " in other countries, and it was only in such a way that a study of that kind could be made really useful.

DR. H. B. MORGAN said he was hoping that someone else would intervene between the last speaker and himself, because Sir John Forbes Watson had stressed the fact that he was speaking as the representative of employers' organizations, whereas he (Dr. Morgan) was medical adviser to the Trade Union Congress General Council, and therefore spoke from the point of view of the workers. He had no desire to follow Sir John in his economic discussion, but would confine himself to the subject-matter of the paper. He differed from Sir John in many of the things he had said, but one point which he made was perfectly true—namely, that this country had a standard of conduct and a code of procedure with regard to factory inspection which were " miles ahead " of the Continent. He had been particularly struck with regard to the statistics for malignant disease resulting from industrial contact with certain oils and tars, benzene, and so on, and he had sometimes wondered whether the Almighty, in His goodness, had given Great Britain especially malignant oils, because it seemed to him that the British statistics were much higher than those of the Continent. But when he went into the matter he found that the oils were of much the same quality, and the fact was that the British statistics were examples of correct reporting, whereas in many cases on the Continent there was either indifference to the amount of malignant disease in industry or deliberate evasion.

One point in the paper had interested him very much. He believed to be perfectly true what Sir Duncan Wilson had said about the change in the worker and his outlook, even the change in his appearance and self-confidence. The proportionate increase—and he stressed the word " proportionate "—in culture in every direction had, in his opinion, been most marked among those who used to be known as the " lower orders." Whether this was a result of social services or because in this country the workers' organizations had had certain advantages not so far given in other countries, he could not say, but he was convinced that the workers had taken advantage as far as they could of their opportunities and had made great efforts to better themselves.

He wished to stress the side of industrial medicine. Even in this

most highly industrialized country there had never yet been a philanthropist who had been good enough to endow a chair of industrial medicine at a University. It was a striking fact that although it was desired to make British work in this field widely known, there was not yet one figure who could speak openly, without the reservation attaching to the medical civil servant, about the beneficent work done in the realm of industrial diseases and the raising of the standard in this respect in this country. Unfortunately, the medical civil servant was hampered by his office. Very fine work—work of great advantage to this country and to the world—was being done by the factory medical inspectorate, and yet, because that work was carried on so quietly, steadily, and unostentatiously, it was not advertised to the world at large. Members of the House of Commons were scarcely ever informed by the Home Secretary of the excellent work which was done, nor did they realize that here was a well-tilled soil, increasing in fertility, and producing excellent fruit.

The Trade Union Congress General Council came into contact with the Home Office and the factory inspectorate, medical and other, and he desired on behalf of his Council to pay a tribute to the excellent work which was being done and to the helpful and considerate way in which their representations were always received. The men in this service did work which was not recognized and never advertised, and the drawback of their position was that they were never allowed to make known what they did.

As an instance of the good work done he mentioned the scheduling recently of chlorinated naphthalene and methyl bromide. This was the result of the experience and knowledge of the Factory Department. Practically the medical men who knew about these subjects could be counted on the fingers of one hand, but this had been done "off their own bat." There never were any paragraphs in the newspapers announcing that such work had been done, which was a pity. After all, although they might attack the bureaucrat - and nobody had done that more than himself—there was much official work that was deserving of high praise. He had been delighted to hear such an excellent retrospective address from Sir Duncan Wilson. Not only was the retrospect pleasing, but the prospect also, and he felt that, with a little more T.U.C. pushing, the factory inspectorate would bring about greater things yet, on both the engineering and the medical sides. He himself was greatly interested in the textile industry, which was as yet far from the ideal in these respects. It was a pity that it had required a war to drive home the necessity of welfare for the textile worker. In conclusion, he would emphasize that Sir Duncan Wilson had given them an address, not controversial, containing a record of work well done upon which he could look back with pride.

Dr. J. C. Bridge referred to the comparative table given in the paper illustrating the administration of the Factory Acts in 1904 and in 1938. The author had given the number of cases of poisoning in 1904 as 656 and in 1938 as 428. But it was necessary to remember

that in the earlier year there were only about five or six diseases notifiable to the department and since that date a very great number had been added, so that relatively the reduction between 1904 and 1938 was much greater than would appear from the table.

The PRESIDENT said with what great pleasure he had listened to this paper, especially as it had some bearing on his work in connexion with the Census of Production. The size of firms and specialization in industry were matters of common interest.

Arising out of Mr. Garrett's remarks, he desired to ask two questions. Were there any statistics of classification of accidents by trades? If these were in existence it would be interesting to learn whether the accidents of particular trades had increased or decreased. The global figure was likely to cover very many changes in the industrial organization of the country during the period under review. It might be that, if an examination were made trade by trade, it would be found that the accident rate had gone down steeply in some cases, and that its high incidence in the aggregate might be due to the relative increase of the more dangerous trades. His other question was whether there was any evidence of a change in the accident rate at the time of the introduction of workmen's compensation, because this had been mentioned as a possible cause of the better reporting of the present time. Was there any definite jump at the time that workmen's compensation came in such as would indicate that better reporting was the cause? This was a matter which could be brought out very well by a study of the statistics of the two or three surrounding years.

The following communication was received from Mr. ROBERT R. HYDE, Director of the Industrial Welfare Society, Inc. :—

I have read Sir Duncan Wilson's paper with much pleasure and interest, but another engagement unfortunately prevents my presence at the meeting. However, I should like to make the following comments. In so many lectures and articles on industry in this country there appears an underlying assumption that large-scale enterprise—that is to say, factories employing over 1,000 work-people- predominates, whereas the truth is, as Sir Duncan has pointed out, that 56 per cent. of the workers are engaged in units of less than 250. Whilst in many ways this fact promotes both stability and a sturdy individualism, there are inherent weaknesses, especially in their inability to promote those comprehensive modern health and welfare services within the factory to which the paper refers. Some of us are at present discussing ways and means of providing in these smaller units some form of the medical service which already has developed with such success in many large firms. Opinion favourable to such a project is rapidly growing.

The speaker mentioned some of the main causes of accidents, but I believe there is a fundamental cause which is not yet fully appreciated. In his all-too-brief reference to the changes that had taken place in industry during the last hundred years he cited as an example the use at the beginning of that period of water-wheels and wind-

mills as a common source of power. It is sometimes forgotten that before the development of the modern factory system—a development almost within living memory—men and women worked in isolation in the fields or in very small groups in mills and shops and houses. Their tools and implements were simple and their movements slow. Within what is but a brief space in human history they have been gathered together in large aggregations with rapidly moving machinery and objects all around them, and are not even yet fully adapted to this new environment. I feel myself that this should be pointed out, particularly to the juvenile worker, who should be taught that, for good or ill, this is a condition he or she must accept, since adaptation to environment is one of the laws of survival.

Sir Duncan made appreciative reference to the growth of voluntary endeavour in that field of progress with which his paper is concerned. One of the most hopeful signs—though not yet fully recognized—in industry to-day is the presence within the factories of an army of welfare workers, employment managers, doctors, nurses, who are not directly concerned with production, but with the human needs of the workpeople. They are scrutinizing industry from within, and there is no doubt that this self-imposed criticism of conditions, the harmfulness or otherwise of material and processes, relationship between executives and operatives is having the most beneficent influence upon the health and general well-being of the workpeople.

The Factory Department have long since recognized the value of this voluntary movement, and in a statement made before the Balfour Committee recorded its conclusion :—

> " State intervention can only go a very small way in promoting welfare work. . . . Theoretically the State could impose on all firms of a certain size the duty of creating a definite welfare organisation, but not only could this not be expected to achieve the same material results as a voluntarily established organisation, but it would lack what is even more important, the spirit by which the organisation should be animated."

The vote of thanks was put to the meeting and carried unanimously.

SIR DUNCAN WILSON, in reply, said that he was gratified to find that there was so little for him to answer. His paper was far from complete, and the subsequent remarks had complemented what he had said. Mr. Garrett had commented on the passage about the ignorance of the factory inspector at the time he joined the service. He thought that there must be some misconception. He had not in the least meant that there were not many admirably qualified and experienced factory inspectors at that time who were excellent trainers of new entrants. He was really referring to his own case and those of others who had had little or no previous experience of factories and who, after a fortnight's training, were supposed to know enough to " stand on their own feet."

Mr. Garrett had mentioned the need for a greater use of accident reports. When he was in office he always used to think what a waste of good material those accident reports were, and when things settled down again it would please him as an old inspector if some thorough-going analysis of those reports were undertaken.

He had mentioned the lessening of severe accidents. The tables and curves given in the paper clearly indicated a large diminution in the number of fatal accidents, and it was fair to assume that if fatal accidents fell, their fall must be accompanied by a diminution of the severe type of accident which was not fatal.

He was sorry that he had made so little reference in the paper to the question of industrial disease, for no one was more conscious than himself of the admirable and successful work that the medical inspectors had done. Dr. Bridge had drawn attention to one instance in which the figures were actually misleading, and he would have this rectified before the paper appeared in the Society's *Journal*.

Sir John Forbes Watson had made the suggestion that he (Sir Duncan) should be asked to undertake an examination of the conditions as regards Factory Legislation in other countries. Well, he would like nothing better, but he was getting on in years, and no one knew when the continent would be a place in which one could freely travel about again. Incidentally, a beginning had been made in 1937, when he attended a conference on factory inspection at The Hague, arranged by the International Labour Office, which was to have reassembled in 1940. He wished to add that the book dealing with the changes in legal requirements brought about by the Factories Act of 1937, which he believed was prepared by Sir John Forbes Watson himself, had been his constant companion when in office. Of all the books published on the new Act that was one of the most useful and the one on which he had made the greatest demands.

Dr. H. B. Morgan had paid a well-deserved tribute to the work of the Medical Inspectors, which he (Sir Duncan) cordially endorsed.

He greatly appreciated the references by Sir John Forbes Watson and Dr. Morgan to the friendly and frank relations that existed between the Factory Department and both the British Employers' Confederation and the Trades Union Congress.

When a young inspector he was, of course, not in a position to know what occurred in the higher places, but he was quite convinced that even during his term of office as Chief Inspector the co-operation had grown ever closer.

He was in full agreement with Mr. R. R. Hyde as to the opportunities for, and value of, voluntary endeavour. In the course of his official life, in fact, he had observed a growing tendency for the factory inspectorate to place their experience at the disposal of factory managements, even in matters that were not strictly legal requirements. This, in his view, was wholly desirable.

The President had asked whether accidents were classified by trades. They were, and very minutely. In every Annual Report of the Chief Inspector a long table was given in which the accidents (both fatal and total) were classified for about 80 industrial groups of

industries according to 27 causations. These were scrutinized every year and inquiry made into the reasons for any marked increase or decrease. Furthermore in 1935 in one of the Shaw Lectures of the Royal Society of Arts, he himself had compared in some detail the hazards in different industries as shown by the variations in accident rates.

He was unable to reply to the question about accident rates just before and just after the introduction of workmen's compensation. It was a point he would look into, but he was doubtful whether anything definite would emerge because comparison between different years was largely invalidated by the effects of several factors, of which the numbers in employment was probably the most important.

Finally, Sir Duncan wished to say that since the paper was written, an Order in Council had been made, transferring the Factory Inspectorate from the Home Office to the Ministry of Labour and National Service for the duration of the war. This step was presumably taken owing to the increase in emergency work imposed on the Inspectorate, parallel with that undertaken by the Ministry of Labour. It is to be hoped that, on the return of peace, the distinction between conditions of *employment* and conditions of *work* may not be overlooked, and that a century's continuous service for a single Department of State will be regarded as a record not lightly to be terminated.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society :—

Elsie Alice Barker.
Kenneth John Burton.
Lawrence William Watson Bushnell.
Juanita Mary Maton.

Leslie Frederick Murphy, B.Sc.
William Penman, M.B.E., F.I.A.
Theodor Prager.
Harold Ernest Raynes, F.I.A.
Gordon Glyn Thomas.

Corporate Representative.

Patrick Gill Griffith, M.B., B.Ch., D.Ph., *representing* Engineering Components, Ltd.

BRITISH PUBLIC FINANCE IN PEACE AND WAR

By C. OSWALD GEORGE, Ph.D.

[Read before THE ROYAL STATISTICAL SOCIETY, June 24th, 1941,
THE PRESIDENT, MR. H. LEAK, in the Chair.]

> " . . . the world must turn upon its axis,
> And all mankind turn with it, heads or tails,
> And live and die, make love and pay our taxes,
> And as the veering wind shifts, shift our sails . . ."

THE field of Public Finance is a very crowded one, which at times
may seem to the hesitant researcher not so much like a field as a
battlefield, and he who enters there may have to run the gauntlet—
on the one side of the advocates of common-sense methods, among
whom may be found some experts and administrators and most of
the ordinary taxpayers; and on the other of a formidable crowd of
scientists and other commentators who find in public finance a happy
hunting ground, but have little else in common. Members of either
crowd may see, in the opposite ranks, quacks with academic qualifica-
tions or experts without; mathematical extrapolators or simple
prophets; cynics who are believed to differ from the abstract
scientists only in their forthrightness; political theorists who get
complex results from the single simple assumption that all people
are equal to one another, and materialistic dialecticians who go one
further and, with pseudo-Euclidean logic, declare that where the people
are equal to anything, there they will all be equal to one another;
and, finally, the common-sense school's particular objects of suspicion,
who at best are regarded as being a little inebriated with their own
virtuosity—the crossword economists and the mathematical econo-
mists. The former are suspected of, dictatorlike, abstracting away
many of men's most powerful desires, sometimes even that of living;
the latter of attaining somewhat similar results by dividing Man
(and tax) into infinitesimally small portions, and not surprisingly
squeezing out many human qualities in the mincing machine of the
calculus.

At the present time the field is even more than usually crowded,
for there are more people than ever before interested in the many
and ever-widening aspects of public finance. From this it might
seem an easy task to choose a subject for a paper likely to be of
general interest. But it was not so. Many of the most attractive-
looking subjects were ruled out by the difficulties or dangers of
obtaining or publishing the necessary data at the present time.
Under all the circumstances it was thought that the most acceptable

paper might be one dealing with our changing financial structure now and during the more or less recent past.

Such a paper may have three main aims : firstly, to give a broad outline of our recent financial history; when faced with new problems, or old problems with new faces, one may perhaps not unprofitably call in History as an ally; and, furthermore, a history which shows us a series of problems, all sooner or later sidestepped or overcome, may or may not be suggestive, but can hardly fail to be encouraging. Secondly, the paper may endeavour to trace some of the main trends and to seek out any likely explanatory factors. Thirdly, if not attempting to forecast the future, it may provide data for mathematical extrapolators or diagrams for less equipped but equally daring mortals to pierce the veil of the future at one or two isolated points with imaginary lines at the end of a graph.

To go back too far into the past would mean that figures would be less reliable or comparable, and prevailing problems differ too much from our own. On the other hand, too short a period would not show up the main trends, and would throw little light on what is at the present time of peculiar interest : the different structures of war and peace finance. Eventually it was decided to take the period from 1888, which offered three convenient peace periods and three war periods.

Next came the problem of compression. In a brief paper it is clearly impossible to deal exhaustively with such a subject and such a period. Eventually it was decided to deal only with the main trends in the revenue and expenditure structure of central finance. This meant ignoring completely many other intriguing questions, such as the economic effects of public finance, the interconnections with local finance, central bank policy, and so on. Even with this limitation, questions seem to jump up and clamour for attention at almost every point, but nearly all of them have had to be left for others or for other occasions. On the other hand, most of the questions actually dealt with are at several points linked together and often mutually explanatory, but it seemed hardly practicable, even if in some ways desirable, to burden the paper with a multitude of cross references; these have therefore been reduced to a minimum.

The main data for our period are shown in Tables I and II. There are obvious difficulties in the way of obtaining a series of figures over half a century which are perfectly comparable, or of explaining briefly every break in comparability. Limitation of space has aggravated these difficulties, but one or two minor alleviations have been possible, such as avoiding the less comparable series or, where reasonably practicable, making actual adjustments; and a short thick line is used, in other cases, as a danger signal when

DIAGRAM I

Totals shown as Percentages of 1913 Levels.
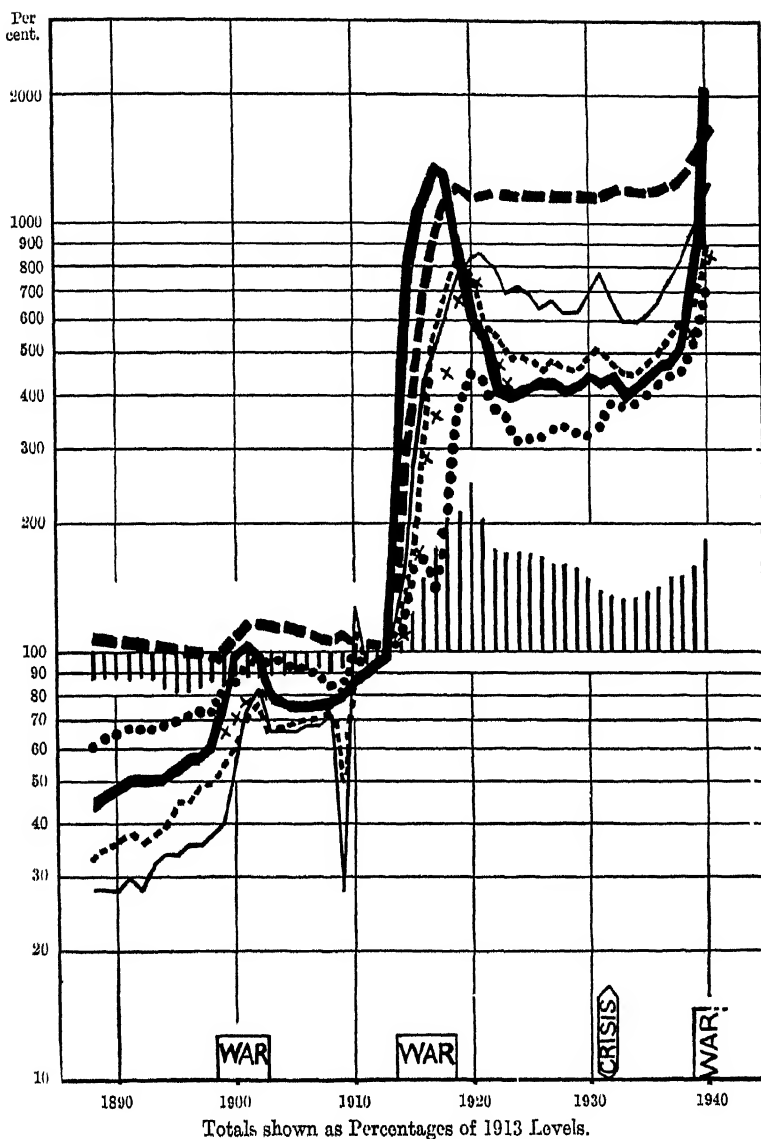
National Debt ■■ ■ ■■; Gross Expenditure ▬▬▬; Gross Revenue (when substantially different from Gross Expenditure) is shown by a X; Revenue from Customs and Excise ● ● ●; Inland Revenue ▬ ▬ ▬; Income and Super- or Sur-tax ▬▬▬▬. Cost of Living (below or above 100)

comparability becomes seriously impaired or disappears. As regards rates of duty, many changes not readily measurable in the specimen rate are indicated by " H " for increase, " L " for decrease, and " C " for an indeterminate change. Limitation of space has also restricted the size of the Tables, but it is hoped that they include sufficient to show the more important changes in our financial structure, and in certain other related factors, such as population, wages, consumption of dutiable commodities, and cost of living. A glance down any of the columns will provide material for thought.

A more compact picture is provided by Diagram I, which illustrates movements of the principal series—National Debt, Gross Revenue, Gross Expenditure, revenue from Customs and Excise, from Inland Revenue, and from Income and Super- or Sur-Tax. The various series of annual figures have been brought to a common basis by reducing each year's figure to a percentage of the relative figure for 1913–14, and then plotted on a logarithmic scale. This method has its weaknesses, but it seemed on the whole the best way of showing at a glance the relative changes from time to time and from series to series over the whole period. For inter-temporal comparisons, allowance must, of course, be made for the changing value of money ; a rough but ready indicator (the reliability of which may vary with series and circumstances) is provided by the vertical lines showing the cost-of-living index as a percentage of its 1913 level. The method adopted is a vertical line drawn downwards or upwards from the 100 per cent. line, its length representing the percentage of the index under or over 100 per cent. in each year. This was done partly for clarity of reproduction, but it also emphasizes the change at 1913. The basic figures up to 1913 are Professor Bowley's cost-of-living index given in his *Wages and Income in the United Kingdom since* 1860. From 1914 onwards I used the Ministry of Labour monthly index to calculate an index for each *financial* year. The whole series was then brought to a 1913 basis.

From the diagram one or two broad points are immediately apparent. Keeping in mind the fact that the vertical measurements are logarithmic, one notices above all the striking difference in the scale and effects of the Boer War compared with those of modern total war. (The Boer War, it will be seen, affected some of the curves less than the temporary upset of the Finance Act of 1909–10.) The diagram also emphasizes the different rates of rise and fall of the different series ; how, for example, war-time expenditure quickly soars above revenue ; and how the war of 1914–18, even after the post-war shrinkages, left expenditure and taxation on a very much higher level than before.

This higher level gave rise in some quarters to ominous comment concerning the " national burden of taxation," a phrase which in a

sovereign democracy can have little meaning, and in any case means little or nothing unless account is taken of the benefits of expenditure. The huge increases in the " national burden of taxation " during and after the last war had, it was suggested, seriously reduced the " national taxable capacity " and sapped our financial strength, by reducing the sources from which any future tax revenue must come.   There is no need here to point out the possible misconceptions underlying the phrase " national taxable capacity " or to discuss the relative unimportance, from the point of view of war potential, of inter-temporal as compared with international comparisons.   But the following Table, based on Professor Bowley's estimates of National " Aggregate Income," * throws some light on the position in two comparable peace years, 1911 and 1936.

PER CAPITA REMNANT OF INCOME (AFTER PAYMENT OF TAXATION)
1911 AND 1936

	United Kingdom (including S. Ireland) 1911	United Kingdom (excluding S. Ireland) 1936
National Aggregate Income ...	£2,150 mns.	£4,440 mns.
	£(mns.)	£(mns.)
Less Taxation (central)	155	783
,, ,, (local)	77	(say) 197
	—— £232 mns.	—— £980 mns.
Remnant	£1,918 mns.	£3,460 mns.
Population	45,271,000	47,081,000
Remnant *per capita*	£42	£73
Cost-of-living index	(say) 97	147
Per capita remnant at 1936 values...	(say) £64	£73

The Table shows that in 1936, with a larger if older population, there was, after the payment of much heavier taxes and rates, a net balance of £73 per head, as against £42.   There is no completely satisfactory method of comparing the value of £1 at the two dates, but if the cost-of-living index be accepted as a basis, the £42 of 1911 might be reckoned as equal to, say, £64 in 1936.   On this basis, then, we may safely assume that, in spite of the much heavier tax demands, the " average " inhabitant of 1936 had a larger tax-paid remnant (for spending, saving, or meeting new war taxation) than his predecessor in 1911.   The conception of " average " inhabitant hides, of course, any changes in tax, income, or age distribution, while capacity or willingness to pay taxation obviously depends on these and many other factors, some of which are dealt with later.   (It may

* See Bowley, *Some Economic Consequences of the Great War*, p. 136, and *J.R.S.S.*, Part IV, p. 517, " Some Constituents of the National Income."   Cf. Bowley and Stamp, *The National Income*, 1924, pp. 46–7.

Financial Year (commencing 1st April)	National Revenue							National Expenditure			Social Services met from				Annual Consumption per capita			Cost of Living Index	Wages Index	Unemployment Per-centage	Popula-tion
	National Debt	Total	Inland Revenue		Customs and Excise			Total	On De-fence	Debt In-terest, etc.	Exchequer		Local Rates, etc.								
			Total	Income Tax and Super- or Sur-tax	Emer-gency Taxes	Total	Pro-tective Duties				Mone-tary	Non Mone-tary	Mone-tary	Non Mone-tary	Spirits	Beer	To-bacco				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	£mns.	n.f. gal.	st. gal.	lbs.				000's
1888	697	90	29	13	—	46	—	87	29	21					0·93	27·2	1·48	88	75	4·9	36,881
9	689	90	31	13	—	48	—	91	31	20					0·96	28·9	1·51	88	80	2·1	37,179
1890	682	96	32	13	—	49	—	95	32	19					1·02	30·0	1·55	89	83	2·1	37,485
1	676	90	33	14	—	50	—	98	31	19					1·04	30·2	1·61	89	83	3·5	37,802
2	669	98	33	15	—	50	—	98	32	19					1·03	29·8	1·64	90	83	6·3	38,134
3	665	98	33	15	—	50	—	98	32	19					0·98	29·5	1·62	88	83	7·5	38,490
4	656	102	35	16	—	51	—	101	35	19					0·97	29·5	1·60	88	83	6·9	38,859
5	648	109	40	16	—	52	—	105	38	18					1·00	29·6	1·60	83	83	5·8	39,221
6	611	112	40	17	—	54	—	110	40	18					1·01	30·8	1·72	85	83	3·3	39,599
7	635	116	43	17	—	55	—	112	40	18					1·02	31·3	1·74	88	84	3·3	39,987
8	628	118	44	18	—	55	—	118	44	17					1·03	31·8	1·82	86	87	2·8	40,381
9	629	130	48	19	—	61	—	144	70	17					1·09	32·5	1·88	91	89	2·0	40,774
1900	639	140	51	27	—	65	—	193	121	19					1·12	31·6	1·95	90	94	2·5	41,155
1	745	154	64	35	—	65	—	205	124	21					1·09	30·6	1·89	90	93	3·3	41,538
2	771	161	68	39	—	72	—	194	101	22					1·05	30·3	1·93	91	91	4·0	41,893
3	763	151	58	31	—	71	—	157	72	20	3				0·99	29·8	1·91	92	91	4·7	42,246
4	755	153	58	31	—	72	—	152	66	20	3				0·96	28·9	1·96	92	89	6·0	42,611
5	743	154	60	31	—	70	—	150	59	19	4	14			0·92	27·9	1·98	93	89	5·0	42,980
6	725	155	61	32	—	69	—	150	59	19		15			0·91	28·2	1·98	95	91	3·6	43,361
7	709	157	62	32	—	68	—	152	58	19	3	15			0·91	27·9	2·05	93	96	3·7	43,728
8	703	152	63	34	—	63	—	152	59	18	3	15			0·86	27·1	2·04	94	94	7·8	44,124
9	713	132	44	13	—	61	—	158	63	18	4	16			0·70	26·1	1·97	96	94	7·7	44,519
1910	685	204	102	62	—	73	—	172	68	18	10	16			0·65	26·4	2·00	97	94	4·7	44,916
1	663	185	83	45	—	72	—	179	71	17	12	16			0·68	27·3	2·05	100	95	3·0	45,271
2	656	189	83	45	—	71	—	189	72	17	19	17			0·67	26·9	2·05	102	98	3·2	45,436
3	650	198	88	47	—	75	—	197	77	17	19	17			0·70	27·8	2·10	100	99	2·1	45,643
4																					

Note: columns 12–15 (Social Services met from) are marked "Not computed" for the earlier years.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1914	1,105	227	103	69	—	80	—	560	437	20	20	17	—	—	0·69	26·7	2·19	108	106	3·3	46,048
1915	2,133	337	169	128	—	120	1	1,559	1,400	58	18	18	—	—	—	—	—	129	108	1·1	44,333
1916	4,011	573	387	205	140	126	1	2,198	1,974	125	20	17	—	—	—	—	—	156	118	0·4	43,710
1917	5,972	707	503	240	220	110	1	2,696	2,403	188	25	21	—	—	—	—	—	183	138	0·7	43,280
1918	7,435	889	622	291	285	162	1	2,579	2,198	268	27	22	30	44	—	—	—	211	178	0·8	43,116
1919	7,829	1,340	716	359	290	283	3	1,666	691	327	29	36	41	46	0·49	17·5	3·96	218	213	2·4	43,599
1920	7,574	1,426	691	394	250	333	5	1,195	292	328	37	49	41	45	0·47	20·9	2·99	255	260	2·4	46,472
1921	7,654	1,125	521	399	43	324	3	1,079	189	307	38	51	36	43	0·39	18·6	2·97	298	246	14·8	47,125
1922	7,742	914	482	379	21	283	3	812	111	299	45	57	35	45	0·36	15·9	2·82	179	198	14·3	44,325
1923	7,641	837	435	330	23	263	3	789	106	307	44	58	38	48	0·32	16·5	2·85	171	187	11·7	44,396
1924	7,598	799	430	337	19	234	1	706	115	312	47	59	43	49	0·31	17·6	2·87	175	194	10·3	44,915
1925	7,559	813	428	323	14	238	2	826	119	308	50	59	39	50	0·31	17·6	2·96	174	196	11·3	45,059
1926	7,555	806	402	301	8	249	5	842	117	319	52	60	38	52	0·28	16·9	3·00	172	195	12·5	45,232
1927	7,528	843	418	311	2	251	6	839	117	314	53	62	38	56	0·276	16·6	3·04	168	196	10·6	45,388
1928	7,591	836	407	291	2	263	6	818	113	312	57	63	39	59	0·265	16·2	3·11	166	194	10·8	45,577
1929	7,469	815	402	294	2	247	5	829	113	317	58	65	38	64	0·264	16·1	3·24	163	193	10·4	45,673
1930	7,413	858	431	324	3	245	5	831	111	293	66	63	41	67	0·239	15·7	3·31	154	191	16·1	45,866
1931	7,491	851	449	364	3	256	5	851	107	289	80	60	43	70	0·221	13·7	3·27	146	189	21·3	46,074
1932	7,645	827	412	312	2	283	26	850	103	282	95	66	45	72	0·200	11·0	3·23	142	185	22·1	46,335
1933	7,822	809	393	282	2	286	33	778	108	216	126	63	43	77	0·203	11·8	3·22	140	183	19·9	46,620
1934	7,801	805	339	280	2	290	34	797	114	212	119	62	43	80	0·198	12·8	3·40	141	183	16·7	46,666
1935	7,796	845	405	289	1	303	36	843	137	213	117	65	—	—	0·197	13·3	3·51	144	185	15·5	46,869
1936	7,797	897	430	311	1	321	39	902	186	211	126	69	—	—	0·209	13·5	3·71	148	190	13·1	47,081
1937	8,026	949	471	355	3	335	45	920	197	216	121	71	—	—	0·215	14·2	3·87	156	197	10·8	47,289
1938	8,163	1,006	520	398	23	341	40	1,019	254	217	—	—	—	—	0·21	14·2	4·00	156	204	12·9	47,494
1939	8,931	1,132	533	460	28	400	37	1,408	659	223	—	—	—	—	—	—	—	165	208	10·5	47,676
1940	11,395	1,495	792	600	97	529	21	3,071	3,220	213	—	—	—	—	—	—	—	190	220	—	—

Col. 1. Year = financial year commencing April 1 in year stated, i.e., 1913 = 1913-14.

Col. 2. National Debt: Net total at end of each financial year. Savings Certificates are shown at issue price exclusive of accrued interest.

Col. 3*. Total National Revenue: Exchequer Receipts, including self-balancing revenue.

Cols. 4*, 5, 6, 7*. Exchequer Receipts.

Col. 6. Emergency Duties = Excess Profits Duty (and Munitions Levy), Corporation Profits Tax, National Defence Contribution, and Excess Profits Tax.

Col. 7*. Customs and Excise excludes motor-cars and cycles since 1911.

Col. 8. Protective Duties = McKenna and Safeguarding of Industries Duties, Hops, Abnormal Importations, Horticultural Products, and Import Duties Acts, Ottawa Duties, Beef and Veal, but excluding goods from Eire.

Col. 9*. National Expenditure. Issues out of the Exchequer, including self-balancing but excluding expenditure not chargeable against revenue.

Col. 10 Defence (and Attack) Expenditure = Army, Navy, and Air Force, plus Votes of Credit.

* The figures in columns 3, 4, 7 and 9 have been revised throughout so as to include for the years prior to 1907, the payments made direct to Local Taxation Account, etc., out of Revenue assigned to local purposes.

Col. 11. Debt Interest and Management.

Cols. 12, 13, 14, 15. Social Services for Great Britain only. See text for details.

Cols. 16, 17, 18. Annual consumption. Calendar year figures.

Col. 19. Cost-of-living index. Up to 1914, Professor Bowley's index (base year "1914"). From 1914, for which I make a rough estimate of 108, I have calculated an index for each financial year from the Ministry of Labour monthly index (base = July 1914 = 100).

Col. 20. The figures shown for the year 1888 to 1914 and 1924 to 1936 are Professor Bowley's index (op. cit.). The remaining figures are very rough estimates of my own made merely to permit continuity in the diagrams. No accuracy is or can be claimed for them.

Col. 21. Unemployment Percentage. Index up to 1921 is the "Annual Percentage Unemployed among Members of Certain Trade Unions." From 1922 onwards the figures are the Ministry of Labour "Percentages of Insured Workpeople Unemployed."

Col. 22. Population: Estimated population, at middle of calendar year, of the United Kingdom. Southern Ireland is excluded from 1923 onwards.

TABLE II

Rates of Taxes, etc

Col. 1	Col. 2	Col. 3	Col. 4	Col. 6	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15	Col. 16	Col. 17	Col. 18	Col. 19	Col. 20	Col. 21	Col. 22	Col. 23	Col. 24
6	5 0																			
7	6 0																			
8				5 0																
9‡		150	4 6	4 6	L			130		R. Ex. R. Cns.			8		14 0		R. Ex. R. Cns.				
1920			6 0	4 0		7 6		162			30 6 50 6 72 6		28 0 14 0	28 0 28 0 14 0	26 6 13 3	25 8	7 0 11 3		6 8	2¼		3½
1§	5 0			5 0			R						8							2R
2	4 6			4 6		2½R										*10 6	L				
3	4 0			4 0	L	R	51				83 0	3 0	4	R	14 0	C		H		
4																				
5			7 6		7 6																
6	4 9										82 6	11 6	6		6	H	H		1 6	C	
7††	5 0	9 0	8 3	9 0			55 60		114 0 80 0	9 6	97 6	13 6	8		8	8	2	H			
8	5 6		9 6	9 6	H	2½R												9			
1939(1)	7 0			7 0						8 10	104 0	15 0			C						
(2)	7 6	120		7 6			60				135 0	17 6				14 0	14 0	H			
1940(1)‡‡	7 6			7 6			100*				165 0	19 6				28 4	28 4	O		4	
(2)	8 0			8 0	H																
1941	10 0	110		10 0		L	L								C						

be added that the 1936 credit balance would be proportionately much smaller if the remnant of tax-paid income were calculated not per head but per adult head or per adult male head.) * But the above figures seem sufficient to dispose of any suggestion that the national reserve of tax-paid income was very seriously lower in, say, 1936 than in 1911. It is, in fact, clear that, *on the assumptions made*, these estimates of the National Aggregate Income showed an increase between 1911 and 1936 which was more than enough to counterbalance all increases in taxation, transfer and non-transfer, central and local, onerous and beneficial.

Theorists have complained that the post-war burden was unnecessarily high because taxation during and immediately after the war had not been increased to the extent or in the ways that it might have been. Yet the practical men might retort that the economists had not been very helpful. For did not most of them, when consulted about that really effective weapon, the general sales tax, merely re-echo what to them were the last words on the subject—the 18th-century Clydeside or seemingly preadamite fulminations against the ancient alcavala ? And almost all other forms of indirect taxation they had damned with ethical curses. As to direct taxation, had they been more helpful ? Practical men might again argue that, as regards the post-war tax suggestions, the economists had spoken with many voices, and during the war had offered little assistance. War-time is essentially dynamic, but their approach had been mainly static. Total warfare obviously demands optimum tax revenue, that is, revenue so calculated and distributed, assessed and collected, as to maximize national war potential (*e.g.*, by minimizing discouragement to production and speeding-up the desired change-over of production and consumption from a peacetime to a war-time basis). And optimum war-time tax revenue (which does not necessarily imply maximum tax revenue, and certainly does not imply maximum tax rates), obviously demands the effective use of changing conditions and of popular conceptions and misconceptions, as well as the balancing one against the other of many factors, psychological, political and administrative, which theorists have ignored or scarcely bothered about. And what the economists termed the elasticity of demand for income in terms of effort had received only slight attention, and then under highly artificial if not impossible assumptions, while longer-run elasticity or elasticity of demand for nominal income seems scarcely to have been thought of. The practical men could at least point to one or two new taxes which, whatever their faults, had produced increased revenue deemed

* Calculations on a similar basis of tax-paid income per *adult male* head give £234 for 1936 against a 1911 figure (in 1936 values) of £233.

necessary for the all-important aim in war-time—to win the war. They met with most success in Inland Revenue (see Table I), and particularly with the Excess Profits Duty, which in a few years brought back into the Exchequer (after they had stimulated production) hundreds of millions of pounds. The indirect tax innovations of the last war were very much less productive but rather more permanent (see Table II).

Returning to Diagram I, one sees that the National Debt in 1913 was higher (although only slightly) than in 1898, thus giving some support to the popular generalization that the debt incurred during one war is not paid off before another begins. And when we come to the next peace period, we find that not only is the preceding war's debt not paid off, but the debt outstanding at the outbreak of the second World War is greater than at the conclusion of the first World War. When we look at national expenditure, we see it rises rather faster than national debt but, when peace returns, it falls much more and much more quickly than debt, although at its lowest point it is substantially higher than its pre-war level.

But graphs alone cannot explain the development and changes in the structure of public finance. Then where are we to look for guidance ? The so-called science of Public Finance seems hardly to have bothered about the problem. Economists, particularly in this country, seem to have been more concerned with ideal tax systems based on abstract ethical principles or equally abstract theories of incidence than with the reasons why public finance is as it is in real life. And most of the political scientists, since Sidgwick at any rate, seem to have fought shy of public finance, unduly alarmed possibly by the terrifying technique of the more mathematically-minded theorists. One may, in fact, read through a modern Grammar of Politics containing half a million words and yet scarcely see once the word " taxation." In short, public finance seems to be regarded as of merely incidental importance in political science (but see below).

The younger science of Public Finance was perhaps born at an unfortunate moment, for sciences, like human beings, are often largely the creatures of their natal environment. Had it been born a little earlier, or even a little later, it might have been given the same first name as its sister science, Political Economy. And a science with the name of " Political Finance " could hardly have ignored the past, present, and future possible or probable changes in the financial structure. It would, no doubt, have sought out possible controlling forces, starting perhaps with the cynical generalization, as old at least as Aristotle, that the class or classes having political power will use that power to maximize their own benefits from the State and minimize their payments to the State.

The modern cynic might argue that public finance during our period simply reflects changes in the franchise, with lags due to the frictions inherent in the political machine and in tax systems. If we look at the following Table, which shows the number of persons on the Register of Parliamentary Electors at the General Elections since 1892 (and at four earlier dates), together with my rough estimates of the male population over 21 years of age, we see how the political centre of gravity in the United Kingdom has changed since the first Reform Act. The turning-point roughly coincided with the

| Year | Males | | Females |
	Parliamentary electorate	Adult population (21 and over)	Parliamentary electorate
		(millions)	
1835	839,000 *	6¼	—
1871	2,553,000 *	7¼	—
1881	3,077,000 *	8½	—
1886	5,707,823 †	9	—
1892	6,161,456	9½	—
1895	6,332,454	10	—
1900	6,732,613	10¾	—
1906	7,266,708	11¾	—
1910 (1)	7,705,602	12¼ to ⎱	—
1910 (2)	7,720,842	12¼ ⎰	—
1918	12,913,166	?	8,479,156
1922	12,011,000 ‡	12½	8,863,000 ‡
1923	12,208,000 ‡	12¾	9,078,000 ‡
1924	12,433,000 ‡	13	9,299,000 ‡
1929	13,657,434	13?	15,193,925
1931	14,098,181	14	15,854,630
1935	14,801,402	14¼	16,571,821

Note.—Eire is excluded in 1922 and subsequent years.
* Mulhall's *Dictionary of Statistics* (1884), p. 164.
† *Fabian Essays* (1889): Sidney Webb's contribution, "Historic," p. 40.
‡ Approximate figures including 180,000 in 1923 and a negligible number in 1923 and 1924 whose sex was not distinguished. With these exceptions, the electorate totals from 1892 are as shown in 83*rd Stat. Abs.*, p. 47.

beginning of our period. Allowing for plural voting, which after 1918 was relatively unimportant, it is clear that the " less wealthy classes " have for some time had an overwhelming voting power. The growing inclusion of women portends interesting variations (into which we cannot enter here), but does not at present seriously affect the main trends. Our cynic might argue that as the less wealthy classes have secured an electoral majority, so has public finance been increasingly manipulated in their interest, the influence of the " social conscience " being more and more submerged by the rising tide of the new political preponderance.

A closely-related view has been put forward by Professor Laski in three characteristically brilliant if rather one-sided studies.* He propounded the new " iron law " that when Democracy could no longer permit the wealthier classes to maintain their customary standards of expenditure and, at the same time, permit a continuous rise in the standard of life of the working classes, then our present Democracy would disappear. But, fortunately for Democracy, this new " iron law " is subject to very substantial limitations even in normal times, and it certainly does not apply when the nation deems itself to be in danger.

The cynic might be prepared to argue that in normal times the taxpayer, irrespective of class, may be broadly regarded as *homo œconomicus* who, like Bennett's Priam Farll, was presumably buried (by over-timorous economists) but lived unrecognized to work in a different sphere. The taxpayer, possibly quite honestly believing he is acting for the good of the State, would thus get all he could for as little as possible—the exceptions to the rule being relatively too few to affect the main trends. But some would see in him maybe a touch of Aldous Huxley's brave neo-Greek heroes, Beta, Gamma and company, others a touch of Stevenson's Jekyll. When danger comes, he is metamorphosed : no longer wanting to get, but, with not easily definable limits and conditions, anxious to give. Danger usually means military danger, war or threat of war, but other moments of serious apprehension (*e.g.*, as in the 1931 crisis) will give rise to similar symptoms. There appears a general willingness, if not actual anxiety, to accept sacrifices, which may vary according to the apparent needs or dangers, but, so far as it can be measured, is not the peculiar possession of any particular class.

Such ideas might be almost sufficient bases for abstract scientists who alone can with certainty link cause and effect or gaze unerringly into the future. Unfortunately they can do so only in a world of their own imagination, yet their conclusions might, failing anything better, serve as guides (or lighthouses) as we go through half-a-century's financial statistics or try to pry into the future. One may easily imagine an abstract theorist in that unborn science of Political Finance producing a thesis dealing with " Public Finance in Myopia." In the country of Myopia, he would assume a few very simple conditions, possibly (1) an effective Parliamentary democracy; (2) a Government with the will to live; (3) an Opposition with the wish for power; (4) an electorate who wish to get as much as possible from the State in return for as little as possible, and among whom the

* Cf. Harold J. Laski, *The Crisis and the Constitution : 1931 and After,* 1932; *Democracy in Crisis,* 1933; *The State in Theory and Practice,* 1934, and my reviews of the two former in *Rivista Internazionale di Scienza Sociali,* July 1932 and September 1933.

less wealthy classes form an overwhelming majority, but with the proviso that when the safety of the State is believed to be seriously threatened (in war or crisis), all classes wish to give, instead of to get, all they can—subject to certain conditions which it is the administration's task to discover.

Our theorist, with these simple assumptions, might then laboriously set out his three cases (1) Peace-time, (2) War-time, and (3) Post-war transition to peace.   From his simple assumptions he would first infer that in peace-time, taxation of the rich would increase and taxation (per capita) of the poor decrease.   This would tend to show itself in continuous increases of direct tax revenue and rates, and decreases of indirect—in so far as existing popular beliefs about their incidence prevailed.   He might, however, treat as special cases, subject to different influences, indirect taxes on morally shady commodities and such taxes as were generally believed to improve employment and wages.   And he might add a reservation that *caeteris paribus* indirect taxes may tend to be stickier than direct, and take a " much longer run " to comply with his conclusions.   On the expenditure side, indirect expenditure (*i.e.*, where the benefit is not attributable to any particular person or class) * might or might not continue to increase, according to various factors, such as foreign social or military development, changes in national wealth, and so on.   But expenditure benefiting the poorer classes would definitely increase under normal conditions, and would become more direct (*i.e.*, in the opinion of those classes more beneficial to themselves).   The further conclusion might be reached that, under certain circumstances, this direct expenditure would take the form of goods or services only where private production could not compete with the State, and that beyond a certain point governmental expenditure would increasingly take the form of direct money payments.

But in war-time (Case 2) maximization of the war effort, he would argue, would entail increased taxation of both the poor and the rich, the relative proportionate increases depending partly on how far the peace-time trends had worked themselves out.   Total expenditure would increase much more rapidly than tax revenue, the amount of the difference, to be covered by loans, depending on such factors as general beliefs (see below) and economic knowledge, and the stage of economic development.   But new expenditure would be for war purposes, while other expenditure, even that on the poorer classes, would cease to increase, and might decrease, even substantially.   In the sub-case 2A (when the apprehension of national danger occurs without war or fear of approaching war, as in 1931), expenditure on the poor † and total taxation might be expected to show the same

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* Cf. Hugh Dalton, *Principles of Public Finance*, 9th edn., p. 207.
† Excluding, of course, expenditure on poor relief and unemployment.

trends as in war-time, but total expenditure, instead of rapidly increasing, might fall substantially.

In Case 3, the post-war transition to peace conditions, there might be a temporary rebound. Total expenditure and taxation and direct tax rates might be expected to decrease, but not to approach their pre-war levels, and sooner or later they would start once more to rise, as in Case 1. On the other hand, indirect tax rates (particularly those on food and conventional necessities) would be expected to decrease, and sooner or later to fall below their pre-war levels.

As for public debt, so long as the ordinary man regards the economic scientist as akin to a Christian Scientist when he preaches that the real burden or pain of taxation is no greater than that of debt, our theorist would possibly argue that there would be a long-run tendency for debt to mount up. In the transition period there might be a temporary decrease, but in war, debt would inevitably and rapidly rise. And he might even argue that eventually debt would show a continuous increase in peace-time.

Finally, he would doubtless cover himself with innumerable reservations as to lags and possible hidden forces. And he would probably emphasize the fact that, in the short run, at any rate, the actual incidence of taxation, assuming it could be satisfactorily defined and ascertained, had little or no importance, but that what did matter was the general beliefs on the subject.* His basic assumptions might be applied to all branches of public finance,† but we already have more than enough for our purpose. Let us, then, look at the relevant statistics, to see if they provide any support for our theorist's conclusions, or his assumptions.

No one, not even an abstract theorist, would expect to find conditions in Myopia duplicated in a country such as ours, with its high political and economic development and its highly developed social conscience. And, in any case, in the real world it must take time for such tendencies to work themselves out. Yet our theorist might claim some resemblance between his results and British public finance. There is no time to make a detailed study of agreements and disagreements of theory with practice, but we may try to make a few broad comparisons, and a rather more detailed examination in two cases : the first case, of war-time indirect taxation, showing marked disagreement, and the second, on the expenditure side, showing some degree of agreement with our theorist's inferences. For the rest, we shall have to leave the Diagrams and Tables to speak for themselves.

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* Hence in this paper direct taxation is held to be synonymous with Inland Revenue, and indirect synonymous with Customs and Excise.

† And, possibly, with amendments, to other systems.

An examination of Diagram I and Table I shows that our theorist's rather obvious conclusions concerning the National Debt are at any rate not seriously at variance with the facts. And in taxation we find much to support him, but there are one or two substantial exceptions. The diagram shows that total Inland Revenue, and still more the yield of Income and Super-tax, broadly supported our theorist, rising rapidly in war-time, then, after a lag, falling somewhat, but never approaching the old level before once more commencing to rise. On the other hand, indirect tax revenue (*i.e.*, Customs and Excise) shows marked divergencies. Under what in retrospect seem the very slight financial stresses of the Boer War, indirect taxation responded almost as well as direct taxation. But there was no very substantial post-war fall. And when we come to the first Great War, there is a very different story. Taking the actual annual figures at their face value, indirect tax revenue did not appear to be very satisfactory. But when allowance is made for the changing value of money, the picture is very much worse. If we reduce the Customs and Excise revenue to pre-war values on the basis of the cost-of-living index, we see that in 1917—the most critical year in Britain's financial history—indirect taxation was a dismal failure. For not only was it not yielding a larger real product than in 1913, but, measured in pre-war values, its yield had fallen by more than a quarter. A glance at Diagram I will confirm this, and show that even in 1918–19 the rise in indirect tax revenue was still only approximately the same as the rise in the cost-of-living index. (Incidentally it may be mentioned that the post-war fall in the price level had the opposite effect; in the year 1924–5, after Mr. Snowden's substantial reductions in various duties, Customs and Excise revenue, measured in pre-war values *on the basis of the cost-of-living index*, was higher than in the years 1919–21, the years of unparalleled nominal increases in the rates of duty.) After some fluctuations, nominal Customs and Excise revenue began to rise for the 1931 crisis, and has risen almost continuously ever since. But if allowance be made for revenue from the hydrocarbon oil duty (£58 mns.), which is not generally regarded as a tax on the poor, and for revenue from the more obviously protective duties (£40 mns.), which our theorist specifically excluded, the nominal total of Customs and Excise revenue in 1938–9 was substantially lower than in 1922–3 (the first year for Great Britain and Northern Ireland only). *Per capita* figures would, of course, show a still greater fall.

When we come to the present war, we find indirect taxation, with its new and wider sources of revenue, including this time a Purchase Tax, roughly running neck and neck (proportionately) with direct taxation—a striking contrast with its performance during the last

war.   Why was indirect taxation so disappointing during the last war ?   Among the various factors may be mentioned (in addition to those dealt with elsewhere) the abandonment of the proposed swingeing increases in alcoholic duties in 1915 and the necessity to restrict consumption of such liquors and tobacco, the inability of newly-imposed indirect taxes (*e.g.*, those on matches and entertainments) to provide very substantial revenue and— in spite of the still-born 1917 Budget proposal—the absence of any general consumption tax.   Part of its work was done by the even more indiscriminate effect of inflationary prices, which, if we accept some critics' judgment, had almost every disadvantage of indirect taxation and none of its advantages.

The indirect tax failure of the last war emphasizes the dangers inherent in any system dependent on one or two commodities only. The great indirect tax revenue producers, alcoholic liquors and tobacco, had yielded in 1913–14 more than 8o per cent. of the total Customs and Excise revenue.   But, however rates had been raised, they could not have been expected, so long as consumption had to be restricted, to have made contributions commensurate with the scale of modern war expenditure.

For any tax system based on two or three commodities inevitably has less elasticity than a more widely spread system, and when great pressure is put upon it, there must always be a danger if not of killing, at least of severely straining the geese called upon suddenly to lay abnormally large golden eggs.   It seems that the egg-laying strain must be more widely distributed if our theorist's dream of maximum (or optimum) war-time indirect tax revenue is to be realized.   It may be noted that in 1921, after the various post-war duty increases, the most popular beer was selling at 7*d.* per pint, of which 3¼*d.*, or 46 per cent., represented duty;   the working-man's shag tobacco was sold at 9*d.* per ounce, of which 5*d.*, or 55 per cent., represented duty; while a bottle of whisky was sold at 12*s.* 6*d.*, of which 8*s.* 5½*d.*, or 68 per cent., represented duty.   At the present higher rates of duty, the percentages of price represented by tax are correspondingly higher.

One wishes in vain for data which would permit detailed statistical studies of tax or demand elasticities for each of the commodities at different periods, and in any case they would hardly be a safe guide to what will emerge from the melting-pot of war.   Yet a little light may be thrown on the problem and, incidentally, on the future, by an examination of the consumption trends of tobacco and the two main alcoholic revenue producers, spirits and beer, before the Boer War, between that war and the first Great War, and between the latter and the second Great War.   A rough idea of the changing trends may be obtained by simply looking at the data in Table I,

but something a little more precise may be gleaned from the equations, computed recently as an experiment, which are embodied in the following Table. Although these equations, which are open to many theoretical objections, are submitted as little more than least-square equations which fit the data, yet they provide reasonably reliable indications of the various consumption trends, and may serve, if not as solutions, at least as pointers to one or two minor

	Per capita consumption		$b_3 \dfrac{M_3}{M_1}$	$b_4 \dfrac{M_4}{M_1}$
	Annual average	Average annual percentage increase or decrease $100 \dfrac{b_2}{M_1}$		
SPIRITS (proof gallons)	pf. gal.	%		
1888–98 $X_1 = +0.457 + 0.00533X_2 + 0.00534X_3 ...$ ...	1.00	$+ \tfrac{1}{4}$	+0.511	—
1903–13 $X_1 = +0.166 - 0.0148X_2 + 0.0144X_3 - 0.0505X_4$	0.81	$-1\tfrac{3}{4}$	+1.687	-0.657
1927–37 $X_1 = -0.00938 - 0.00742X_2 + 0.00330X_3$ ...	0.23	$-3\tfrac{1}{4}$	+1.238	—
BEER (standard gallons)	st. gals.	%		
1888–98 $X_1 = +18.451 + 0.517X_2 + 0.252X_3 - 2.452X_4 ...$	29.88	$+1\tfrac{3}{4}$	+0.806	-0.527
1903–13 $X_1 = -2.081 - 0.301X_2 + 0.331X_3$	27.66	-1	+1.111	—
1927–37 $X_1 = 7.551 - 0.310X_2 + 0.165X_3 - 0.0657X_4 ...$	14.08	$-2\tfrac{1}{4}$	+0.994	-0.398
TOBACCO (lbs.)	lbs.	%		
1888–98 $X_1 = +1.186 + 0.0296X_2 + 0.00286X_3$	1.64	$+1\tfrac{3}{4}$	+0.167	—
1903–13 $X_1 = +1.305 + 0.0219X_2 + 0.0108X_3 - 0.0116X_4$	2.01	+1	+0.512	-0.226
1927–37 $X_1 = +4.749 + 0.106X_2 + 0.00992X_3 - 0.0261X_4$	3.36	+3	+0.251	-0.856

Note.—An equation for Spirits (1888–98) with three independent variables gives $X_1 = -0.815 + 0.00128X_2 + 0.0102X_3 + 0.0795X_4$, which appears to indicate its own redundancy.

though interesting problems. The average (adjusted) annual percentage changes in consumption $\left(\dfrac{100\, b_2}{M_1} \right)$ for each period and each commodity are shown in column 3 of the Table, and for ready comparison, the corresponding average annual *per capita* consumption is shown in the preceding column.

The data available presented certain obstacles. First of all, it was clearly impossible to find periods of peace of statistically satisfying length and free from disturbing factors; the equations are actually based on three eleven-year periods, the first immediately preceding the Boer War, then the subsequent peace period 1903–13, and finally, avoiding the General Strike, the period from 1927 to 1937. Secondly, the consumption data are not financial-year but calendar-year figures,

which, though less suitable from some points of view, are better for our purpose, since, smoothing out Budget oscillations, they are thus more reliable criteria of changes in consumption.   Thirdly, *per capita* consumption figures offer the advantages of removing the disturbance due to changing trends in total population and (in part) the departure of Southern Ireland from the United Kingdom.

Details of the variables are as follows: X_1 = the *per capita* calendar-year consumption of each commodity as shown in Table I; in most cases these are the Statistical Abstract figures, but, where deemed desirable, minor amendments have been made (*e.g.*, the beer figures are to the nearest tenth instead of the nearest hundredth, while, on the other hand, the spirits figures for 1927–37 are newly calculated to the nearest hundredth). X_2 = the progressive number of the year, starting at 1 for each period. X_3 = the percentage employment for each calendar year (*i.e.*, 100 less the unemployment percentage); unfortunately no suitable unemployment index covering the whole of the last fifty years is available, so for the first two periods the basic data are the well-known index for " certain trade unions," but—and this should be remembered throughout—the figures for the period 1927–37 are the Ministry of Labour " percentages of insured workpeople unemployed." X_4 = the main rate of duty for each commodity.   For the years when rates were changed, the increase (or decrease) shown is proportionate to that fraction of the calendar year for which the new rates are in force.   This course is not without disadvantages, but, as so often happens, one has to compromise between precision and convenience in the light of one's principal aim, here the calculation of average annual changes in *per capita* consumption.   In the equations, changes in the rates of duty have been ignored only where they seemed of insufficient importance to justify an additional independent variable (but see footnote to Table for the special case of Spirits in 1888–98).   The equations in each case show coefficients to three significant figures, but this is merely for uniformity, and in no way meant to imply a spurious precision.

Let us translate the results into ordinary language.   Never forgetting the numerous assumptions underlying the various calculations, we may perhaps safely assume that in the pre-Boer War period, after allowing for changes in employment (and duty), the *per capita* consumption was increasing in all three cases.   The b_2 coefficients suggest that the average annual increases were, say, 0·005 proof gallons of spirits, a little more than half a standard gallon of beer, and 0·03 lb., or nearly half an ounce of tobacco.   More easily comparable are the average percentage yearly changes $\left(\dfrac{100\,b_2}{M_1}\right)$, which suggest

that *per capita* consumption of spirits was increasing at the average annual rate of, say, ½ per cent., and that of both beer and tobacco at the faster rate of about 1¾ per cent.

But we find an entirely different story in the case of the two liquors when we come to the next peace period. Here we find that, instead of increasing, *per capita* consumption was now falling, and at the substantial rate of, say, 1¾ per cent. for spirits and 1 per cent. for beer. An interesting conclusion emerges. It seems hardly likely that such a reversal of the trend can be imputed, in the case of beer, to increases in the duty, seeing that between 1888 and 1903 such increases were not very substantial. The case seems rather clearer as regards spirits, where there were no really appreciable duty increases until 1909,* yet an examination of the data from 1903 to 1908 supports the idea that *per capita* consumption had not only ceased to rise, but had definitely begun to fall before there was any appreciable increase in the duty. Insufficiency of data precludes any precise statistical analysis of the effect of duty changes, but, after allowing for rising wage rates and other factors dealt with later, there seems ground for believing that this important change in social habits originated, not in war-time or other increases in the duties, but in moral or other factors. Be that as it may, the important point for a Chancellor of the Exchequer was that before war came in 1914, the consumption of two of his most important revenue commodities was rapidly falling. Yet, as the later equations suggest, the position was even worse when war broke out once more in 1939, for not only had consumption fallen to a much lower level, but it appeared to be falling at a greatly accelerated rate. How far this was attributable to the heavy increases in duties and how far to other factors, one can hardly even guess. But *per capita* consumption (adjusted) was falling at the average annual rate of, say, 2 per cent. for beer and 3 per cent. for spirits, figures which might be exhilarating to moralists, but could hardly be so to a Chancellor of the Exchequer. The writing was on the wall. An indirect tax system based almost entirely on two or three morally shady commodities could not be expected to respond effectively to the demands of another war on the grand scale.

Yet there was one relieving feature. The tobacco figures show that consumption was on the rise in each of the three periods, and rising faster in the last than in either of the other two periods, suggesting that even continuous duty increases had not yet reached optimum point. The foregoing results are broadly corroborated by inter-period and inter-commodity comparisons of average annual

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* The 1888–98 spirits equation in footnote to Table seems to suggest that the duty changes had little definite effect on consumption.

consumption (column 2), which show striking variations in the three periods. A further comparability is supposedly possible by calculating the average employment and duty elasticities $\left(b_n \dfrac{M_n}{M_1} \right)$ in columns 4 and 5. But it need hardly be added that, where data are so scanty, such comparisons are extremely speculative and at the best are a mixture of suggestiveness and danger, a mixture which to some minds may be attractive. With these reservations, the figures are included in the Table to permit comparison with analogous calculations on rather different bases for other or longer periods.* Some may find interesting similarities and characteristics in the series of elasticities. Others, perhaps, may think the most surprising feature of the equations is that, under all the circumstances, they are as consistent as they actually are, and that, with the possible exception of the equation mentioned in the footnote, they do not seriously diverge from common-sense expectations.

It is interesting to consider how far the history of these alcoholic liquors, with the striking falls in consumption and increases in rates of duty, has been influenced by the ideas powerfully put forward by the temperance movement. And there are other cases where ideas, without, however, any specific supporting organization, have materially influenced financial policy. During our period the broad peace-time trends have undoubtedly been substantially affected by two superstitions, one mainly tending to hinder, the other to reinforce the general trend. Both seem in some degree a mixture of those two great mesmerists of the human mind, ethics and mathematics, which together often form an apparently irresistible combination. Can there, for example, be many phrases so influential, so ubiquitous, as "fifty-fifty," which so often seems as simple, as fundamental, and as indisputable as the twice-times table? In taxation, at any rate, a variety of the "fifty-fifty" principle was at one time very influential. Perhaps its greatest prophet was Gladstone, who, with almost Freudian touches, enhanced its appeal; Justice was deemed to demand that the tax burden should be divided equally between "the two beautiful sisters," direct and indirect taxation, and from this it was often assumed that the burden would thus be shared equally by the rich and the poor. The conception was sufficiently vague (in application) to be used in favour of either more or less of either form of taxation, but during our period it has on the whole tended to hinder the shrinkage of indirect taxation. Today the absolute sovereignty of the fifty-fifty rule in taxation has gone, although its influence has by no means entirely disappeared. It is impossible to say how far its dethronement was due to the gradual

* See, *e.g.*, Dr. V. Edelberg's paper, *J.R.S.S.*, Vol. CIII, Pt. II.

realization of some of its logical weaknesses * and how far to the appearance of a rival superstition more in accord with the times, ethically more egalitarian and mathematically more complicated, yet possessing the politically essential characteristic of superficial simplicity.

The newcomer was the belief in the representative man's curve of sacrifice or utility which, according to the theorists, was based on the law of diminishing utility. Many writers argued that this curve, coupled with the principle of equal sacrifice, demanded progressive taxation—a palpable fallacy.† Less obviously fallacious was the argument that coupling the curve with the principle of minimum sacrifice logically involved and ethically justified the lopping off by taxation all incomes above any desired level. Much of the influence of this theory sprang from its stark simplicity. Yet without adopting the criticism of the school which tilts at all interpersonal comparisons, one may wonder whether the representative man's curve is not basically a fallacy, arising out of the attempt to solve a dynamic problem by a static theory, itself the offspring of middle-class intellectualist empathy and one of Man's greatest intellectual difficulties—that of appreciating or even conceiving the financial problems or hardships of any man richer than himself. For if the representative man's curve is a sound concept, it automatically follows that a tax of, say, £500 on an annual income of £1,000 involves the same sacrifice, irrespective of whether a man's income has been stationary for some years at that level, or has suddenly risen to £1,000 from, say, £100, or has suddenly fallen to £1,000 from £10,000. To many people, and particularly to the man with the falling income, such an idea will seem utterly fallacious. But if it be once admitted that the man with a falling income has a different "sacrifice" or "utility" curve from one with a rising income, the representative man's curve will be obliterated by a mass of curves for incomes rising and falling from innumerable points and at innumerable rates. And if the representative man's curve falls, much tax theory falls with it. Yet what is important from our present point of view is not the logical soundness or unsoundness of this theory (or its possibly adverse effects on tax practice and optimum tax rates), but the fact that it was and is generally accepted, and has without doubt materially influenced financial thought and policy by reinforcing the peace-time political trend.

Keeping these various points in mind, let us now see how far

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* *E.g.*, see Diagrams II and III and the curves of income tax exemption limits.

† Since the assumption that marginal utility falls cannot by itself justify such a conclusion. The crucial point is the *rate* at which it falls, and on this point the representative man's curve, paradoxically enough, tells us nothing.

rates of duty have varied in accordance with the Myopian conclusions. The changing rates are shown in Diagrams II and III; here semi-log paper offered certain advantages, including the clearer treatment of the period before 1913, and the ready comparison of rates of increase not only in any periods from or to 1913, but also, merely by drawing imaginary lines in any other periods on the same or different curves. Incidentally the changing tax " burden " may to many seem better represented by proportionate (logarithmic) than by absolute changes. The diagrams show two examples of direct, three of luxury indirect, and two of breakfast-table indirect tax rates.   Diagram II shows the yearly percentage level of each rate compared with that of the base year 1913.   Our theorist might find most support in the two direct tax curves : income tax (normal or standard rate) starts at the low level of 43 per cent. of the 1913 rate, rises for each war (and crisis) and sinks partially and temporarily during the transition periods. Super- or sur-tax (maximum rate), first imposed in 1909, shows similar rises, without, however, any fall at all throughout our period. A curve is added to show percentage changes in the income-tax (earned) exemption limit.   This limit, which falls to enlarge the tax net and rises to make it smaller, might be expected in the long run to rise rather than fall, but to fall for war and to rise in the subsequent peace period.   The diagram shows that the slight rise in 1894 was maintained until the last war, which brought a fall, followed by a post-war rise to just above the 1914 level; then came the 1931 crisis fall, and further falls for this war (cf. next diagram).

As for indirect taxes, the beer duty shows slight rises up to the Boer War, then a rather larger rise, and then remains unchanged until 1914 and the post-war danger years, when much heavier increases appear. After a post-war drop, the 1931 crisis brought another rise and fall, and then the present war lifted it to 2,129 per cent. of its 1913 level.   The tobacco duty, on the other hand, has shown an almost continuous series of rises, mainly at danger periods. A different course is followed by sugar and coffee.   The sugar duty, reimposed for the Boer War, fell six years later, and rose for the next war, then fell by more than a half, and rose for this war.   The coffee duty passed scatheless through the Boer War, rose for the next, but by 1924 had once more fallen to its ancient level.

Percentage changes in the cost-of-living index are again shown as in Diagram I.   The changes in the cost of living provided interesting comparisons, particularly since 1913, and throw some light on such matters as consumption trends or real yield.   It will be seen, for example, that the spirits duty did not rise as much as the cost of living until 1919, nor the tobacco duty (definitively) until 1921, while from 1924 the coffee duty, now fallen to its old nominal level, was,

DIAGRAM II

Changing Rates as a Percentage of their 1913 Levels.

Super- or Sur-tax ▬▬▬; Income Tax ————; Income Tax Exemption
Limit ooooo; Duty on Beer — — —; Spirits ▪ ▪ ▪ ▪; Tobacco ● ● ● ●;
Sugar ▬ ● ▬ ● ●; Coffee xxxx. Cost of Living (below or above 100 %)
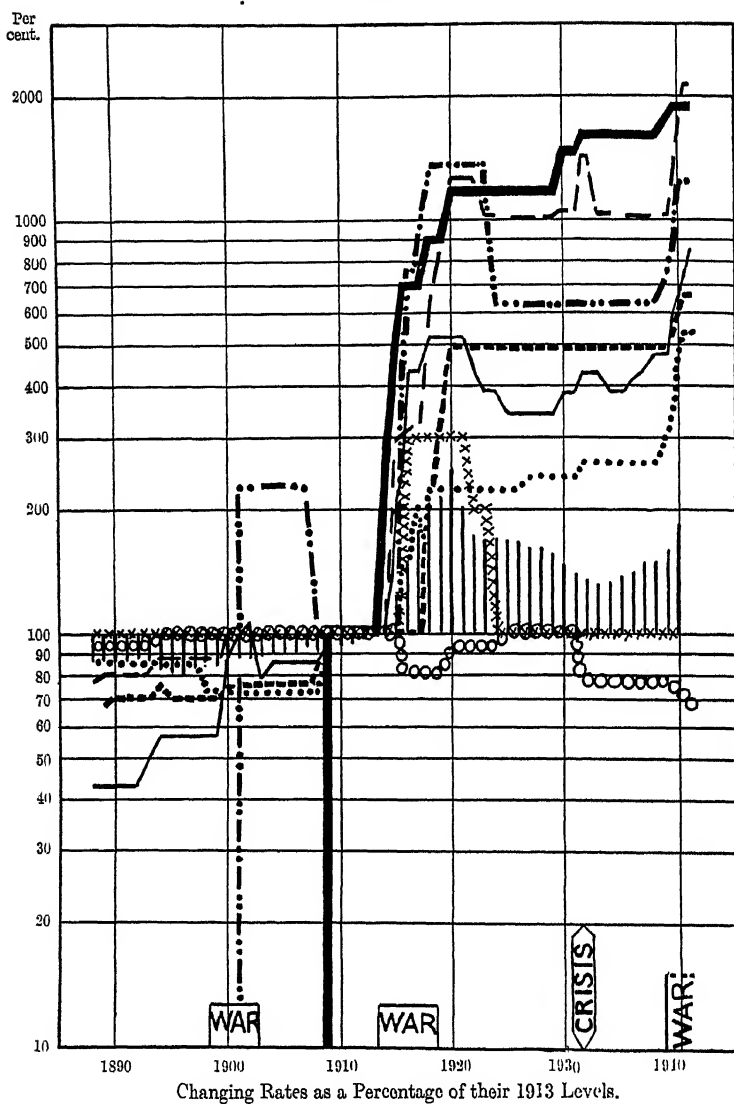
in view of the higher general level of prices, a relatively much lower burden.

Yet such matters were seldom or never fully realized by the general public. Before the 1941 Budget, comments were often heard that certain indirect tax rates had been subjected to heavier proportionate increases than income tax. This could not be denied if one considered only the period since 1913 and the nominal rates (see Table II). But these obviously give only a part of the story, for the income tax is, as it were, *ad valorem*, while the indirect taxes illustrated are specific, thus ignoring changes in prices, wages, and so on. Corrections might be made on the basis of the cost-of-living index, or of the level of nominal wages or real wages, each of which would tell a part of the story. The level of nominal wages is the basis adopted in Diagram III, which thereby attempts to show various indirect tax rates, as it were, as income taxes on wages, *on the assumption that consumption remains unchanged throughout.*

In this diagram the income and super- or sur-tax rates are shown exactly as before. Then the various indirect taxes are considered as income taxes on wages—that is, it is assumed that in 1913 a working-man buys such amounts of beer, tobacco, or other commodity as would represent, in beer duty, etc., some given proportion of his wages (say, for simplicity's sake, 1s. 2d. in every £ of his wages, the 1913 income rate). Then there is calculated the proportion of his wages (which are assumed to vary with the wage index) represented by the duty payable each year in respect of the given quantity of each dutiable commodity. This calculated proportion is then reduced to a percentage of the relative 1913 figure, and these annual percentages are depicted on the diagram. Such percentages are not free from criticism, but they are a better indication of the "real" burden than the nominal duty rates, and they are also likely to have a closer connection with consumption. They also show greater "long-run" support for our theorist. At the same time, these various factors emphasize the disadvantages of fixed specific as distinct from *ad valorem* duties in war-time or at any time when wages (and prices) are rising, and more particularly if supplies are limited as in the last War. For if prices rise substantially, the value of the duty per unit of commodity will correspondingly fall without any counterbalancing effect from increased consumption.

Diagram III also includes an additional curve showing the changing exemption limit (earned) from income tax as a percentage of its 1913 level, after adjusting for changes in the wage level; that is, the figure plotted for each year

$$= \frac{100 \times \text{current exemption limit} \times \text{wage index for 1913}}{£160 \ (\textit{i.e.} \ 1913 \ \text{limit}) \times \text{current wage index}}.$$

DIAGRAM III

Changing Rates as a *Percentage corrected for changing Wages.* (Base Year = 1913 = 100%.)

Super- or Sur-tax ▬▬▬ ; Income Tax ————; Income Tax Exemption Limit oooo; Duty on Beer — — —; Spirits - - - -; Tobacco • • • • •; Sugar —••—••; Coffee x x x x.

The plotted figure therefore provides an indication (though maybe a rough one, particularly for long periods) of how the income-tax net is widened or narrowed by the combined effect of changes in the exemption limit and the changing level of wages.   The basis, for the years 1888–1913 and 1924–36, is the authoritative wage index of Professor Bowley in his *Wages and Income in the United Kingdom since 1860,** which gives details of the difficulties and limitations of such estimates, and is an invaluable guide to the whole period.   In order to permit continuity of the curves, I made estimates (see Table I), for the years 1914–23 and from 1937 onwards, which are of necessity only very rough, but are sufficiently near the mark for this purpose.   It is interesting—in spite of the inherent frailty of all long-period index figures—to compare the plotted figures for, say, 1936 (exemption limit £125, wage-index 192) with the plotted figure for 1888 (limit £150, wage-index 76), which is nearly three times as high.   The whole curve illustrates one of the many dangers of re-garding the proportions of direct and indirect taxation as a safe criterion of the relative tax burdens of the " rich " and the " poor."   And the curve agrees even less than the uncorrected curve in Diagram II with the Myopian theory, particularly in the long-run trend, but it might be argued that lag would be greatest in directions such as this where increased taxation may be caused by monetary or similarly less obvious changes.   Before we leave taxation, we may add that war and crisis prepared the way for the introduction—or rather re-introduction—of Imperial Preference (1919) and a little Protection (1915 and 1921), followed in 1931 onwards by their much fuller development (see Tables I and II).

Passing to expenditure, a glance at Table I and Graph I is sufficient to show that total expenditure has in the last half century increased almost continuously in peace-time, increased much more rapidly in war-time, and then, when peace has arrived, fallen, but not reached its pre-war level before a further rise has manifested itself.

Table I shows some of the more influential items.   A great part is obviously played by defence (and attack) expenditure, which, in war-time, is seen to rise at an alarming speed, alarmingly fast or alarmingly slow, according to the viewpoint or the particular Whitehall window of the observer.   An increasingly important part is also played, as the Table shows, by debt interest, which, in spite of post-war cuts, stood in 1939 at a much higher level than in 1914.   But in this war a different financial policy may already be traced in the

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* These figures, and the cost of living index up to 1913, are reprinted in Table I by kind permission of Professor Bowley and the Cambridge University Press.

DIAGRAM IV

Expenditure on "Social Services."

Central : "Monetary" ▬▬▬ ; Central : "Non-monetary" ■ ■ ■.
Local :   ditto   ———— ; Local :   ditto   ▬ ▬ ▬.

Cost of Living ꜟꞁꟷ
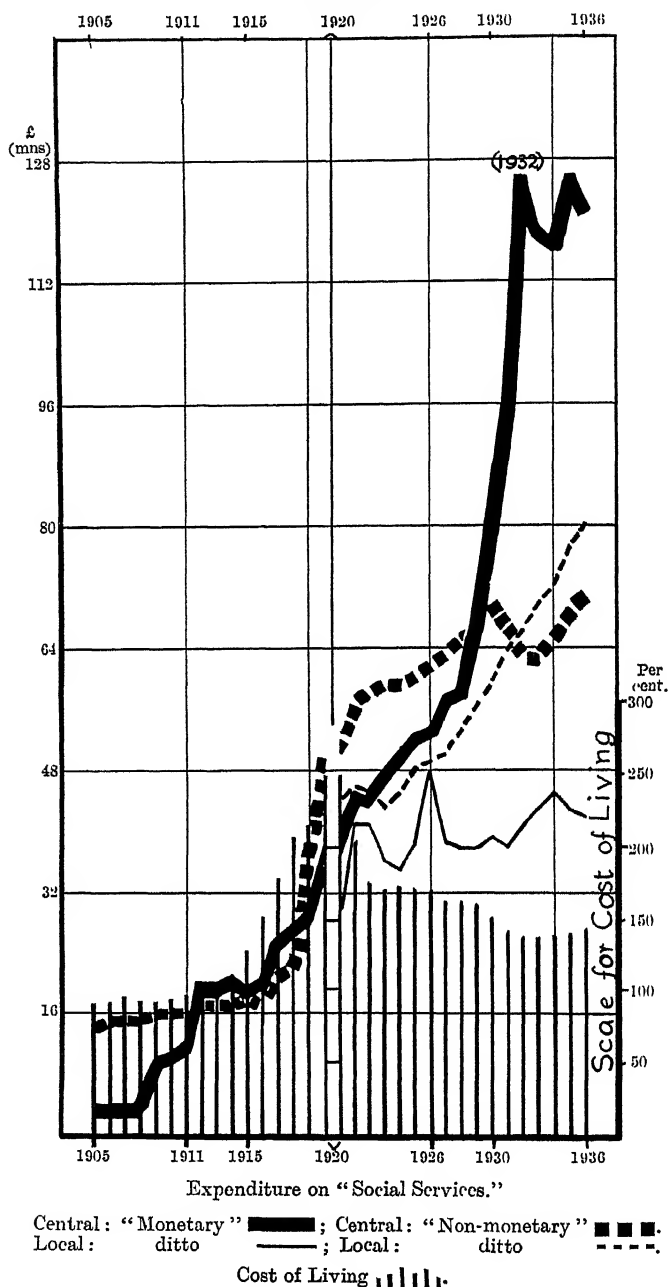
substantially lower interest rates and more slowly rising charges, a factor likely to be of ever-increasing importance as the war progresses.

More definite support for theory is found in the different trends showing themselves in the expenditure presumed particularly to benefit the poorer classes through the so-called Social Services. There is no lack of statistics, but the inevitable problems of comparability over such a period as ours become much more apparent when an attempt is made to extract any particular class of expenditure, such as that on the Social Services. For the later years (from 1920–21 to 1936–37),* we are fortunate in having the annual Drage Return with profuse detail of every kind. But, unfortunately, sufficient particulars are not given to enable one to trace precisely equivalent totals for earlier years. It is, however, possible to get official figures broadly corresponding to the main items for earlier years, and these permit a fairly complete picture to be built up over a longer period. (It must be noted that these figures, like those of the Drage Returns, are for Great Britain only, and exclude Ireland throughout.)

In the diagram the right-hand portion is based on the figures of the Drage Returns, Central and Local Government expenditure being each classified under two heads, " Monetary " and " Non-monetary." This classification may not always be precisely clear-cut, but is intended broadly to distinguish those services which in the main do, from those which do not, reach the beneficiaries in the form of money payments. Central Government " Monetary " includes Parliamentary Votes and Grants for Poor Relief, Old Age Pensions, Unemployment Allowances, and National Health and Unemployment Insurance. Local Government " Monetary " includes expenditure from the rates (and, since 1930, Block Grants) on Poor Relief only. " Non-monetary " (Central or Local) includes the remainder of the Drage Return items, that is, Education, and very much smaller sums under the heads of Housing and Hospitals, Lunacy, Mental Deficiency, Inebriates, and so on.† War Pensions, however, have been excluded throughout since, for our present purpose, they are better regarded as war costs than as social services.

The left-hand portion of the diagram represents similar, but not precisely comparable, totals of " Monetary " and " Non-monetary " services met from Parliamentary Votes and Grants of the central government only. Here " Monetary " covers central expenditure on

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* The year 1936–37 is the last complete year for which the Drage Return was published. Certain details have, however, been printed in Hansard for July 2nd, 1940 (now O.P.), and February 5th, 1941.

† For particulars of the various services, see the important Paper by Sir Gwilym Gibbon, C.B., C.B.E., D.Sc., on " The Public Social Services," *J.R.S.S.*, Vol. C, Part IV (1937), which contains invaluable details and analysis.

Old Age Pensions, National Health and Unemployment Insurance, and Poor Relief (in this period Poor Relief was perhaps less " Monetary "). To emphasize the different bases, the diagram is clearly bisected; but a comparison of the 1920 figures, which are calculated on both bases and are represented in the appropriate half, suggests that the earlier figures are sufficiently complete to permit the diagram to provide a reasonably reliable guide for the period as a whole.

Keeping in mind, then, the limitations of the diagram, we may visualize the main changes over three decades, and we see that there is much support for our theorist. In peace-time, expenditure on the Social Services almost continuously increased, but during the war years 1914–18, if allowance be made for the reduced value of money, not only did such expenditure cease to increase, but it appeared to fall. The cost-of-living index, which may perhaps be accepted here as a reasonably reliable criterion of changing values, is plotted on the diagram, and shows such a steep rise from 1914 to 1919 as more than to counterbalance the rise in nominal expenditure on these services.

Furthermore, a striking feature of central finance during the period shows itself in the much more rapid rise of " Monetary " services compared with " Non-monetary." It might be suggested that the rapidity of the increase of " Monetary," accentuated particularly since 1929, is a temporary phenomenon due to increased unemployment, and that a slackening would be apparent with increasing employment after 1936–7, the last year represented, but this would not completely explain a long-term tendency which the diagram suggests has operated over a period of at least two or three decades.

It may be noted that, since 1930, the distinction between central and local expenditure on the Social Services has been rather blurred by the De-rating Block Grants. To complete the picture, therefore, graphs are included in the diagram showing expenditure on " Monetary " and " Non-monetary " Social Services by the local authorities and met by local rates (and, since 1930, Block Grants). These local expenditure graphs go back only as far as the Drage Returns, since, unfortunately, reasonably comparable figures for the earlier period were not obtainable. One feature clearly illustrated by these graphs is that the expenditure of local authorities, who are subject to different influences * from those impinging on the central government, show quite different trends; local " Monetary " services show no great tendency to expand, while local " Non-monetary " services

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* Cf. those countries where local authorities may be subjected to influences comparable in some ways to those impinging on our central government. For the influence of poll-tax payers on American local finance, see Eugene E. Oakes, *Studies in Massachusetts Town Finance*, especially Chs. II and III (but cf. Ch. IV, p. 130).

(mainly Education) increase continuously and rapidly. How far these different trends are due to the various peculiarities of local government can, of course, only be surmised, in the absence of a much more detailed analysis than is here practicable.

Limitations of space preclude the discussion of any more of the innumerable questions which the data seem to provoke. It is the unfortunate fate of a paper such as this to rouse many problems and to solve few. But it is hoped that the diagrams and the details given in the Tables may go a little way towards answering a few of the many questions left unanswered.

DISCUSSION ON DR. GEORGE'S PAPER

DR. R. G. HAWTREY said that it was a great pleasure to him to propose a vote of thanks for this very stimulating and refreshing paper, which put out, if not absolutely new ideas, at any rate ideas in new guise and in a form to make one think. Proposers of votes of thanks could not devote their speeches to commendation. It was a tradition that a vote of thanks was rather like a game of darts with the reader of the paper in the position of St. Sebastian.

Dr. George had referred to the "fifty-fifty" tradition, which he identified with Gladstone. His own figures, however, showed that the "fifty-fifty" proportion between direct and indirect taxation was first reached by Mr. Lloyd George. Moreover, in the nineteenth century, when Gladstone was concerned with public affairs, indirect taxation was always far above half, and it was usually when there was a Tory government involved in imperialistic finance that direct taxation had to be put up. Income tax was put up in wars, large or small, and was put down afterwards, and it would fall to Disraeli's lot to put up the tax and to Gladstone's to put it down.

With regard to the figures that Dr. George had produced showing the elasticity of the response of liquor and tobacco to rates of taxation, the results were interesting, and as far as they went convincing, but the chief criticism that occurred to him about them was that the effect of a high duty was very protracted. The author had referred to the continuous decrease in consumption of liquors in recent years. It seemed to him that they were still feeling the effect of rises of duty on spirits and beer in the early twenties, but it took a whole generation for the full effect of a high duty on such things to make itself felt. He quite realized that there was no such effect apparent in the particular case of tobacco, but, for all that, he did not think it at all militated against the well-founded belief that the gradual fall in the consumption of liquor was very largely due to the high rate of duty.

He was not quite convinced by the scepticism Dr. George professed with regard to graduated taxation. Dr. George regarded the

belief in highly graduated direct taxation as the successor of the
" fifty–fifty " idea, and seemed to regard it as equally ill founded.
In the speaker's view the belief in highly graduated taxation did
not depend on any mathematical formula in regard to the diminished
utility of money as the individual's income increased. He thought
it was based on a direct judgment as to the sacrifice involved in
given percentages of taxation. People believed in highly graduated
taxation because they believed that in all the circumstances large
payments could be better spared by the rich than by the poor.

One or two little points in the paper seemed to require correc-
tion. Dr. George had referred to the dislocation due to the budget
crisis of 1909 as greater than that due to the Boer War. As a
literal statement of statistical fact that might be defended, but it
had no real substance in it. The apparently greater dislocation in
1909–10 was due to the delay in the passage of the budget, which
led to a large part of the revenue of one year being paid in the
following year. If the two years were taken together there was
very little dislocation indeed.

The growth of debt between the last war and this did not seem
to be quite satisfactorily described in the paper. It was quite
true that at the outbreak of the present war the debt was higher
than at the end of the last; but he thought it was legitimate to
make a correction of 550 million pounds for money placed in the
Exchange Equalisation Account. Whether it was held there in
British Government securities or gold or foreign exchange, it seemed
to him reasonable to deduct it as an asset from the gross debt.
Moreover, he thought that account ought also to be taken of the
fact that, from the point of view of expenditure, this war began
three years before the outbreak of hostilities, and expenditure on
armaments was on a large scale during the year before the war.

He was not quite satisfied of Dr. George's accuracy in one
small matter—though it might be that he was perfectly correct—
namely, the general sales tax proposed in 1917. He had not the
slightest recollection of such a proposal being made, and if it was,
it was news to him that it was ever turned down on the advice of
academic economists, or even that any academic economist ever
disapproved of it.

He supposed that the main theme of the paper was the behaviour
of the people of Myopia. He liked that parable; it seemed like
the use of economic man by the classical economists. It helped
clear thinking, even if it merely invited one to think where it was
wrong. To think merely why it was wrong in this particular case
would be a fairly fertile source of ideas. It would be much more
correct to say that, whereas democracy did open the door to a
new deal, which leaders in this country had been favouring and
promoting, the modern development of warfare was creating a
terrible fiend, in the form of total war, which descended upon us
every now and then, and blighted the field which had been sown for
social services. He did not think it would be at all legitimate to
generalize about that. If this blight of total war was going to
continue century after century, the world was going to be very

different from what it was before 1914, and perhaps more like what it was in the eighteenth century, so that he did not think the plan on which the country of Myopia was based had very much relevance for the present society.

One other point. He did not think that the crisis of 1931 could fairly be called a state of national danger in the same sense as an outbreak of war. The thing that frightened people then was extravagant expenditure. It was rather natural that that particular form of panic about national security should take the form of economy in all directions—perhaps one might say a rather disastrous economy in certain respects. But the thing that people were then fearing was something much more superficial than the fears of 1914 or 1939.

He apologized for the rather scrappy nature of his criticism—his " darts." But he desired to end by saying how genuinely he felt his indebtedness to Dr. George.

Mr. HENRY CLAY, in seconding the vote of thanks, added his congratulations to Dr. George on having produced so stimulating a paper. He had put together a great deal of material in a little space and in convenient form, and for that reason the paper would be used by everyone who had to refer to statistics of public revenue and expenditure. He, too, had been struck by the independence of his approach and his success in forcing on them a new approach to a number of old problems. All that he himself could do was to make two or three reflections concerning points on which the paper might serve to correct, not perhaps habits of thought common among scientists but certainly habits of thought common in popular discussion of public finance.

The first was the habit of thought of treating direct taxation as a net burden without regard to what was obtained for the taxation. No serious student of public finance, of course, was guilty of this mistake when he thought about it, but unconsciously all of them were at times inclined to compare taxation at one period with taxation at another and regard the increase as simply an increase in a net burden. Dr. George had warned them against that habit in his text, and he thought that his tables and diagrams also pointed to the true conclusion to be drawn from the enormous increase in taxation over the last generation. In one of the footnotes to the table showing the increase in taxation he calculated that the tax-free income per adult male was about the same, if allowance were made for the change in the purchasing power of money in 1936 as compared with 1911. The real income of the country, using the same index-number, showed an increase of over one-third, only a part of which was attributable to the increase in the population. Where had that one-third gone if not into the pockets of producers as tax-free income? A part of it could be written off as increase in what was called transferred income. There was an increase of nearly £200 million in national debt service, of £150 million in monetary social service, and of over £100 million in increased cost of defence, but that still left an increase (in nominal terms) of over

£1,800 million to be accounted for. It would need a much finer analysis than had been possible in the paper to explain where that all went, but Dr. George had established a *prima facie* case for assuming a fairly extensive change in the national habits of consumption. What had happened in the last generation was that people had decided to " do themselves better " as citizens. One of the contrasts between democratic countries and the countries which had suffered—or enjoyed—absolute rulers, particularly in the eighteenth century, was that the latter had much better built cities, subsidized opera houses and theatres, public galleries, and so on. It was only in the last generation that the people in this country began to spread themselves in the same directions. That was a significant change. A larger proportion of income was being spent on communal provision. The change here had taken place almost unconsciously, whereas the dictatorships on the continent had adopted it as a conscious policy.

In the second place, it was a dangerous habit to treat the figures of income before tax and before including free or subsidized social services as representing the true distribution of social income. There was a large correction to be made for the inequality in the incidence of these. Dr. George would not allow them to use the old convenient index of the distribution of taxation between rich and poor, direct taxation representing the rich and indirect the poor. But the heights to which income tax and supertax had mounted and the increased social expenditure could be taken as indicating the change.

The third point which had particularly attracted his attention, and which he welcomed, was the stress Dr. George had laid on the dynamic character of public finance problems. He did this, of course, primarily by directing attention to the change over a very long period, and graphically by representing this change on a ratio scale. It seemed to him important because a dynamic approach to the study of changes in taxation was really at least a useful supplement, and possibly much more, to the static analysis of capacity to pay. In the study of trade fluctuations over the last generation an enormous amount of work had gone into tracing the lags between forms of payment, debt, categories of prices and charges, and so on; in studying the problem of the burden of taxation something of the same sort was required. A mere increase in a man's liability to taxation, due not to increase in income but to a stiffening of the rate of taxation, did not do anything to relieve him of burdens and charges which he incurred years before he thought there was going to be a war, and which he could not shake off merely because he had to pay more income tax.

In the most penetrating and probably most widely read pamphlet on war finance, Mr. Keynes's *How to Pay for the War,* the analysis of the problem was dynamic. The author began by pointing out that there were going to be large increases in public income, and unless these were subjected to some form of levy, they would operate to inflate prices. But when he came to his actual prescription or solution, his treatment was static. He did not propose

that a levy should be made on increases in income proportionate to the amount of the increase, but proposed a levy (which would be practically indistinguishable from additional income tax) on incomes as they happened to be. Thus to take Dr. George's example a person whose income had gone down from £10,000 to £1,000 would pay exactly the same amount of levy as the person whose income had gone up from £500 to £1,000. That showed the importance of this approach, because the capacity to pay depended a good deal on the antecedent position of the taxpayer as well as on the absolute amount of income on which he was assessed. If his income was increased, it was reasonable to suppose that he could pay some additional taxation. If his income was diminished, the additional taxation imposed would be a disproportionate burden. But this year's budget had taken the view implied in Mr. Keynes's proposal rather than in his analysis, and must have the effect of leading to a good deal of living on capital, which released no resources, as a rule, for the national war effort.

There was one other point to which he desired to refer. He hoped, as a non-smoker, that someone would draw the attention of the Chancellor of the Exchequer to Diagram III. Obviously the Chancellor could come very materially to the assistance of his colleague at the Board of Trade, who was seriously embarrassed by the appetite of the public for tobacco, merely by raising the tax on tobacco in the same ratio as on spirits and beer and in the ratio in which income tax had been raised.

Dr. H. W. Robinson said that Dr. George had entered the battlefield of Public Finance with a whole armoured division and had gleefully disorganized the belligerents—a rare experience for both sides that would, no doubt, lead to a beneficial renovation of their arms. The paper had made use of a number of " secret weapons " that, in many ways, had opened up a new technique in the theory of Public Finance by emphasizing the political influences which, in the long run, determined the development of taxation and expenditure. As it would be impossible to discuss all the ideas and problems suggested by Dr. George without writing a whole book, Dr. Robinson was compelled to limit his observations to a few selected problems.

The table showing the *per capita* remnant of income after payment of tax provided food for much interesting speculation. Professor Clay had already commented on this, but Dr. Robinson proposed to walk deliberately into the trap and leave Dr. George or other speakers to extricate him. In the first place, it was surprising to find, after a quarter of a century of technical progress, that at 1936 values the remnant had only increased from £64 in 1911 to £73 in 1936, an increase of one-seventh. This increase was even disappointing when it was remembered that in those 25 years man's demands had been stimulated by the introduction of the cinema, the radio, the motor vehicle, and the system of hire purchase. Yet it seemed that, for the mass of the population, the power to purchase had risen by a trifling amount. Further, the out-

look was even more forbidding when account was taken of the fact that, whereas the average size of family was 4·6 persons in 1911, it had fallen to about 3·7 *older* persons in 1936, so that the " family remnant " was reduced from £290 in 1911 to £270 in 1936. There was some temptation to fear the progress of science when it created expensive appetites which economic progress appeared to leave largely unsatisfied. Professor Clay had gone some way towards reassuring the Society on this point by investigating how the greatly increased government revenue was spent. His approach might provide some answer to the riddle.

The small increase in the *per capita* remnant might help to explain the trends in the *per capita* consumption of beer, spirits and tobacco as shown in a later table. Since 1911 the possible directions of expenditure which competed for the surplus income left over after providing for the bare necessaries of life, had been multiplied fivefold. While the " morally shady " trinity remained, the advent of the cinema, the dog track, the motor vehicle, the urge for house-ownership, and a host of minor competitors had progressively extended the field. The expenditure on beer, spirits and, if account was taken of the new phenomenon of female consumption, probably also tobacco, had gone down. This was, no doubt, because the new competitors, besides absorbing all the increase of £9 a year, had also taken up quite a lot of the former expenditure on beer, spirits and tobacco. For this reason it would perhaps have been interesting also to study the yields, in peace and war, of taxes on these new commodities, such as the entertainments tax and the road tax, which have, and no doubt will, provide the Chancellor of the Exchequer with important sources of revenue.

Perhaps the most impressive of the many interesting theoretical sections of the paper was Dr. George's revelation that the representative man's curve of utility was no foundation for tax theory. This " scientific " basis of progressive taxation was seen to be a mere superstition, and it was now for the political scientist or the economist to find some more valid basis on which to justify the popular passion to level up all incomes.

The four simple assumptions of Dr. George's new theory of Public Finance were clearly successful in explaining much of the actual course of revenue and expenditure. War conditions presented, however, a more complicated combination of factors than could be allowed for. It might be argued that, in war-time, two main factors swamp all others in determining financial policy : first the need for revenue on an unprecedented scale, and second the need for maximizing the war effort, which, of course, involved considerations of labour supply, consumption, shipping and foreign exchange.

Dr. Robinson concluded by saying how stimulating and instructive he had found the paper. He trusted Dr. George could be relied on to elaborate his interesting analysis, and apply it in his future papers to later periods.

MR. A. D. WEBB desired to offer a few comments on the indirect taxation aspect of this paper, and to do so from the practical point of view. He thought that Dr. George was under the impression that indirect taxation was, or at any rate ought to be, indefinitely extensible, and that there were three things which stood in the way. The first was the opposition of those who happened to have political power—nowadays the great majority of the adult population. The second and third were the " two superstitions " of the " fifty–fifty " ratio, and the principle of minimum sacrifice. It must be recognized by everybody that it was quite impossible to have an extension of indirect taxation, if it was to be lucrative to the Exchequer, which did not fall, directly or indirectly, on the great bulk of the population. This was another way of saying that it must fall, at least in part, on the poorer sections. That set a practical limit to what the Chancellor of the Exchequer could hope to do in the way of imposing indirect taxation. It was true that the working classes had political power in their hands which they could exercise if they chose, and it must be expected that they would seek to prevent an undue extension of indirect taxation. As it happened, this action would not conflict with either equity or economic principles.

As for the " fifty–fifty " ratio, there never was a time when this ratio could be said to have established " absolute sovereignty." He thought that Dr. George had read history wrongly when he described Mr. Gladstone as being the chief prophet of that principle. The ratio in Gladstone's budgets was nothing like " fifty–fifty," but nearer " seventy–thirty." What Gladstone meant in his eloquent reference to the " two beautiful sisters " was that, while perfectly impartial as regards their merits, he was equally attracted to both damsels, and if he wanted more revenue there would be no ground of principle on which he would choose one rather than the other.

The speaker might be doing Dr. George an injustice in attributing to him a desire for an indefinite extension of indirect taxation, but he seemed to support such an attitude by belittling the existing system of indirect taxation. For instance, in making one comparison he omits the revenue from the oil duties and the protective duties. If one is allowed to juggle with figures like this, excluding £100 millions from one side of the account, the most wonderful conclusions and deductions became possible. Dr. George omitted these items because, apparently, they were not regarded as " taxes on the poor." But a very large proportion of the oil revenue was derived from petrol and other oils used not by the rich motorists, but by transport undertakings, goods vehicles and industry, and thus had to be paid in the last resort by the population at large. Most of the protective import duties also fall ultimately on commodities which are consumed by the bulk of the people, and unless it could be supposed that these duties were being paid for us by the foreigner it must be concluded that they were being paid by (among others) the poorer sections of the community.

Further, there was some confusion in the references to the number

of commodities on which the existing indirect taxation system mainly depended. In one paragraph Dr. George states that the "indirect tax failure" of the last war emphasized the dangers inherent in any system dependent on "one or two" commodities only. In the next paragraph this becomes "two or three" commodities. In fact, the present system covers at least six important commodities. Whereas before the last war, in 1913–14, the Exchequer was getting £75 millions a year from indirect taxation, just before the present war this had risen to £340 millions, and this year the budget estimate was over £500 millions without counting the new purchase tax. If this was included, the Exchequer stood to get something of the order of £600 millions by indirect taxation. Not such a bad showing! Incidentally, why did Dr. George quote coffee as though it were something of importance in this connection?

He wished to make one comment on the statistical analysis which Dr. George had given concerning the consumption of spirits, beer and tobacco. He did not want to belittle this statistical exercise, he admired it. But when Dr. George concluded that it was something which would be useful to the Chancellor of the Exchequer he wanted to point out that the table would be of no use to him whatever in making up his budget. The speaker had great respect for statistical analyses of this sort, and it was all to the good that masses of statistics should be tabulated and reduced to simple terms, and that trends and so on should be indicated. But when the Chancellor of the Exchequer came to make up a budget all that he was generally concerned with was what was going to happen in the next twelve months. Although Dr. George suggested that the consumption of spirits and beer was declining steadily and fairly heavily before the present war as well as before the last war, the consumption was not diminishing immediately before these wars; that is to say, it was not diminishing during the period on which the Chancellor of the Exchequer would frame the estimates for his budget.

The speaker's remarks might have sounded hostile to Dr. George, but they were not intended to be. It was usual on these occasions to be critical as well as commendatory, and that was all to the good, because it was desirable that these papers should go forward with as much authority as possible, and that their readers should have guidance as to any necessary qualifications.

MR. NORMAN CRUMP desired to refer, in the first place, to the antagonism between direct and indirect taxation. He was reminded that here it was a question not of comparing taxation and public finance in peace and in war, but, in practice, of comparing them in peace, in war, and in total war, and the third was a very different thing from the other two. He had tried to imagine the remote possibility—or rather the impossibility—of all the members of the present Government resigning and being succeeded by a modern Pooh-bah. Pooh-bah in his capacity as Chancellor of the Exchequer would be inclined to complain that he could get a magnificent yield from indirect taxation if it were not for that wretched figure,

Pooh-bah, at the Board of Trade, aided and abetted by the Pooh-bah at the Ministry of Food, and the Pooh-bah who was in the chair of the National Savings Committee, who were doing their best to cut down the spending power of the people of this country. In these days when it*was desired to cut down ordinary civil consumption there was a paradox between the statutory ration and restriction of consumption on the one side and the reliance upon consumption for the purpose of raising revenue on the other.

If it were possible in theory he would like to see war revenue entirely raised by direct means, taking away the money from everybody when they earned it, not when they came to spend it. Of course, that was not possible. Another object of war budgeting—a concealed object—was to nationalize war effort as far as possible, to draw up taxation so as to encourage everybody to put his utmost into his contribution to the war. That meant that taxation had to be applied in such a way that it did not seem too burdensome, as direct taxation did. Direct taxation was clearly seen, indirect taxation not so clearly. To put the matter plainly and shortly, one wanted to leave everybody not only with a modicum of spending power, but with one or two surpluses in the bargain. A very interesting argument could be developed from that as to the proper way in which to assess war taxation : what proportion of a man's income ought to be taxed, whether it ought to be confined to that portion which he devotes to current consumption, competing with the war effort, and whether he ought to be relieved of taxation on the income which he spent on rent.

He might perhaps develop a shade further this intriguing argument when he came to revise his remarks for the *Journal,* though he bore in mind that Pooh-bah had rationed that most important commodity, paper.*

Dr. EDELBERG said that he would refrain from any criticism and confine himself to what he hoped might be a constructive suggestion for using budget policy as an instrument of general economic policy in the future. The whole national income and employment depended largely on the level of Government expenditure. Reference might be made to an interesting paper in the *Economic Journal* two or three years ago by Dr. Kalecki, who argued the case for raising some of the required money by means of a capital levy, because he found that to be the least depressing method of raising money by taxation, if one considered the inducement to private enterprise to invest. As to the object on which the Exchequer should spend the greater part of the money, there were still many avenues of economic development that could be financed at home, and, secondly, it would be more generally recognized now that it would be part of the national duty to help to finance the capital development of overseas backward countries.

[After the meeting Dr. EDELBERG sent the following additional comments] :

* A prolonged illness unfortunately prevented Mr. Crump from expanding his comments as he had hoped to do.—(ED.)

There are a few points which would be of interest to the student of economic regression, but on which I had to turn up my own numerical conclusions given in the article quoted by Dr. George (*J.R.S.S.*, Vol. CIII, Pt. II).

First, the stability of the elasticities, particularly of their orders of magnitude, discovered by Dr. George for the period 1888–1937 (table, p. 252), is remarkable, and provides a good lesson for facile critics who assume that econometric constants are necessarily unstable.

Secondly, Dr. George has made the mistake of ignoring the lag (averaging about one year) which I found to exist between changes in employment and the changes in consumption of beer. If he had taken the lag he would have secured a better fit and found his cycle-sensitivity (employment elasticity) of 0·944 raised to something nearer my estimate of 1·4 (see my "reply" in the *Journal* referred to above, p. 190). Otherwise our conclusions about beer, spirits and tobacco agree very well. Thus, the elasticity of beer consumption with respect to the rate of duty Dr. George finds to be 0·4 approximately (1927–37) and my equation (5) gave it as 0·5 approximately (1920–38). Similarly, his estimate of the cycle-sensitivity of spirits consumption, 1·2 (for 1927–37) agrees with my 1·3 (for 1922–37). Here the "imperfections" of my data (errors in the tax-yield due to forestalments, etc., etc.) are seen to be unimportant, as, in reply to Dr. George's criticism, I predicted on the basis of my knowledge of the mathematical tools.

Indeed, it should be stated quite generally that mathematical knowledge helps to develop that sense of the order of magnitude which is so vital in practical affairs because it ensures doing first things first. It is fortunate therefore that many mathematically trained persons possessing such a sense are to be found in the higher administration of the country.

Mr. G. L. SCHWARTZ said that it was pertinent to ask what was the relevance, social or economic, of all these fiscal statistics. There was no doubt that although when pressed they realized and acknowledged that the money was not thrown by the Treasury into the sea or used to pay an indemnity to a foreign country, nevertheless these statistics were associated in the public mind with a burden. Periodically in the House of Commons the representatives of the Treasury furnished statistics showing that the amount of taxation per head in Britain was about £16, in Germany about £11, in France £8, in the United States £5, and a hollow groan went round the House, and next day the newspaper headline was "John Bull Pays Most." Again, he was quite certain that most people were under the impression that after this war the country would suffer under a "crushing burden" of taxation. Was there any meaning in this concept of a burden of taxation? Was there any meaning either collectively or individually? Not only were the statistics deceptive as to a burden on the country as a whole, but they were also deceptive as showing the monetary burden upon different classes of the community. It would be remembered that

very elaborate statistics had been worked out—*e.g.* in the Colwyn Report— whereby a person like himself could look down a table of figures and discover his burden to the nearest penny. But inasmuch as he benefited from the expenditure of the Universities grant and as his clientele were supplied him by the expenditure on public education, he was quite unable to calculate whether he gained or lost by the expenditure under the aegis of the budget.

But these figures were associated in the public mind with the concept of a burden. That day most of those present had subscribed freely to the Alexandra Rose Fund. But suppose the Government next year decided that instead of allowing the collection of money in that way they would take the average of the last seven years and pay to the hospitals that amount. The statistics would show a further upward trend in public finance, both in revenue and expenditure, but it would have no significance in real terms. To take a more blatant example, he would assume that women spent £20 millions a year on cosmetics. Imagine the consternation if it were decided to supply these cosmetics through the medium of public finance ! On the very next day gilt-edged would fall three points. There would be a howl from industrialists about the increased burden on industry. There would be a demand for higher tariffs to offset the handicap on British industry in competition with foreign countries. A large number of persons would be grumbling that they were not prepared to pay for the " bedizened hussies " of other men. But as far as the community was concerned, both before and after, £20 millions of real resources would be devoted to the manufacture and distribution of cosmetics. Later, people might change their minds and come to regard it as a public amenity that ladies should be decorated, and once that was accepted the fiscal problem would be solved.

This idea of a burden, he thought, went back to the time when public finance was mainly devoted to war purposes and one did actually have the choice between guns and butter. The population was sensible enough to realize that money which might have been spent on butter was being spent on guns, and although pure economists might demonstrate that the services of soldiers were just as productive as the services of dairy-maids, the public knew that guns filled no hungry bellies, and therefore the money taken away from them did represent a burden. But that concept had no meaning in these days when the greater part of the money was spent on welfare goods and services.

He wished to make one other point. The proposal that a distinction should be drawn between taxation of rising incomes and taxation of falling incomes would have one devastating result, namely, that the Prime Minister would pay a higher rate of taxation on his official salary than Lord Simon, the Lord Chancellor. If such a tax were ever put into force he would like to hear the opinion of the Prime Minister on this strange outcome of the policy regarding Manchuria, Abyssinia and Munich !

(At this point the vote of thanks to Dr. George was put from the Chair and carried unanimously.)

MR. J. E. ALLEN sent the following contribution :

I am very sorry to miss the discussion on Dr. George's paper, but before it is read I must be in Yorkshire, so I send the following comment.

On p. 240 I may observe that the combined effect of taxation and the depreciation of the pound sterling during and after the last war was to transfer a large share of the national income from the propertied classes to the wage-earning and salaried classes. This process has continued, at a higher rate of speed, during the present war. Having regard to the large and general increases of wages and earnings and of the smaller salaries, I believe that the working classes have made no net contribution to the financial cost of the war, since they have a larger net income after allowing for all war taxation than they had in 1938.

So long as the Government is the chief employer of labour, as it must be during a war, indirect taxation brings in little net revenue. What taxation the wage-earning classes actually pay is largely counterbalanced by the subsidies. Rationing, too, means more equality and less of everything else. Perhaps (p. 245) Aristotle and Dr. George are right in thinking that this is a logical development of democracy. "Minorities must suffer."

To my mind the purchase tax or general sales tax is the worst possible way of raising revenue, since it falls most heavily on those least able to bear it. In many trades wages are regulated by the Cost-of-Living Index. As Professor Bowley pointed out 20 years ago and as *The Economist* has demonstrated in a recent article, the Cost-of-Living Index is illusory in war-time, if only from the fact that the pre-war standard of living, which the Index postulates, cannot be maintained because the supply of goods and of services is no longer there.

Nowadays, I believe, the important fiscal distinction is not that between direct and indirect taxation, since even income tax tends to be shifted to the employer, but between escapable and inescapable taxes. No one is compelled to pay the beer, spirits, tobacco and petrol duties. Apart from these four favourites, a Finance Minister, in war-time, should rely on the income tax, and everyone above the poverty level should pay it. This war has been financed with more wisdom than the last war, especially by Lord Simon's first war budget, brought in 3½ weeks after the outbreak of war, whereas in the last war the first *real* war budget was not brought in until 14 months after the outbreak. Where, as I think, Lord Simon and Sir Kingsley Wood have failed is in not lowering the point of total exemption from income tax for single persons to some such figure as £70 a year. It ought not to be possible for any able-bodied worker to evade his share of the national effort by taking " days off."

A correspondent reports a conversation with a manager from the Clyde who says that "large numbers had worked it out to the last penny what they could earn without paying income tax, and did not do a stroke more, so are absent for days at a time."

DR. GEORGE, in acknowledgment, said it was once suggested that at the Royal Statistical Society a vote of thanks might be neither a vote nor thanks, but on this occasion he was pleased to find it had been both.   As it was already time for the meeting to close, he would have to adopt the traditional course of replying in the *Journal* to the questions raised.   Most of these perhaps arose from the difficulty of covering so wide a field in a brief Paper, a difficulty accentuated by the present exceptional restrictions on space.   He had been obliged often to make a sentence do the work of a paragraph, an adjective the work of a sentence.   Yet he hoped none of his over-worked adjectives had been as misleading as that in the newspaper headline " Amazing Statement by the Bishop of Grantford," which was followed by details of the Bishop's admission that he had never in his life known what it was to be drunk.   Dr. George thanked the Fellows present for their kind reception of the Paper, particularly those who had taken part in the discussion, and he subsequently wrote as follows : Dealing first with the vexed question of what Gladstone said in 1861, I hoped it was clear that the paragraph dealt only with ideas as distinct from practice, and that the tables and diagrams would prevent any misconception.   When, long ago, I had the pleasure of reading a long sequence of Budget speeches, and for many of them all the subsequent speeches in both Houses, I was so struck by the persistence of the 50–50 idea in its various forms—equal amounts of direct and indirect taxation, equal shares in any reduction or increase, etc.—that I tried to track it to its source. I worked back to the " beautiful-sisters " simile, and found in Gladstone's published correspondence earlier traces of the pregnant phrase " due proportion between direct and indirect."   Whatever Gladstone precisely meant, or meant to say, in 1861—a question on which those who remember their Morley and Northcote may not like to be dogmatic—his " sisters " simile was often used, or misused, in support of the 50–50 idea.   I tried to summarize all this in my brief and incidental phrase, the word " prophet " implying that Gladstone, like the early Biblical prophets, foreshadowed—not necessarily precisely   coming doctrine and events.

Taking the other points raised by Dr. Hawtrey in order : (i) many theoretical bases for progressive taxation have been propounded—the Paper attacks one only, that of the representative man's curve of sacrifice or utility; (ii) I hoped my one and only reference to the " temporary upset of the Finance Act of 1909–10 " made it clear that the upset was only temporary; (iii) in the Debt totals, allowance might well be made for the Exchange Equalisation Account millions, as indeed for many other credit or debit items, but space preventing any preparation of a National balance sheet, it seemed preferable to give only the figures of what the Treasury itself declares to be National Debt; (iv) the parenthetical refer-ence to the 1917 Budget was not intended to imply that a general sales tax was proposed.   To avoid misconception, the phrase " general sales tax," with its popular content, was pur-posely excluded, and reference was made instead to a general consumption tax, conceived as a tax on a group of objects as distinct

from any specific commodity. (Few or none of the so-called
" general " taxes are free from very wide exemptions.)   Bonar Law
told us that a proposal for a general tax, the precise form of which
was not disclosed, was conceived in 1917, but was discarded before
the appointed Budget day.   The following year, a Budget Resolution
for a " luxury " duty of one-sixth *ad valorem* actually saw the light of
day, but, although not living to maturity, it was, as readers of the
relevant and, in parts, unusually light-hearted White Paper (101,
1918) will agree, a very lively youngster; (v) the problems of tran-
sition from peace to war, under the given assumptions, may be vital
for society and the State, but, unfortunately, space and other
considerations precluded their discussion in the Paper; (vi) Dr.
Hawtrey's suggestion that Myopia has little resemblance to present
society may not, judging from the discussion, meet with unanimous
acceptance.

I can only express my thanks to Mr. Clay for his profound and
suggestive comments, which may well stimulate thought and further
research on the subject.   The same applies to Dr. Robinson's original
and stimulating remarks, and I regret that space restrictions preclude
any adequate treatment of them here.

Mr. Webb, in his defence of indirect taxation, obviously spoke
with deep emotion, but if he re-reads the Paper he will, I think, find
few or none of the opinions he ascribed to me.   I at no time suggested
that indirect taxation was indefinitely extensible, for this is palpably
impossible—assuming normal monetary control. The obvious point
that extended indirect taxation will fall partially on the poor, far
from preventing its extension, may in fact be the precise reason for
such an extension, if optimum taxation is to be achieved.   But
war-time optimum taxation, as stated in the Paper, requires of
course due co-ordination of calculation and distribution, of assessment
and collection.   As for belittling indirect taxation, I pointed out how
in this war it was running neck and neck with direct.   The com-
parison of 1922–3 and 1938–9, with and without the oil and protective
duties, was obviously not to belittle indirect taxation, but was, as
stated, merely to compare actual conditions with the abstract
theorist's ideas of an imaginary Myopia.   Nor were these two
duties temporarily excluded because their incidence allegedly did
not fall on the poor.   Incidence was not mentioned in connection
with the protective duties at all, while in the case of the oil duty,
the reference was not to the incidence, but to popular beliefs about
incidence—a vitally different matter.   Many prevalent theories
are so divorced from reality that, if Mr. Webb is maintaining his
avowed practical point of view, it would be interesting to know
precisely how he defines or calculates the incidence of, say, the oil
duty, and how much, if any, now falls on the Government—if
incidence can fall on a Government.

Mr. Webb impugns the suggestion that indirect taxation was,
for war purposes, inordinately dependent on two or three morally
shady commodities—before the imposition of the purchase tax.
Yet if he compares total customs and excise revenue in 1940–1 with
that of 1938–9, he will find an increase of £188 millions, or, excluding

purchase tax, £162 millions. But revenue from spirits, beer and tobacco alone increased by £171 millions! The oil and protective duties, far from being the support he suggests, fell by many millions, and simply threw additional work on the old basic mainstays.

I cannot quite follow Mr. Webb's objections to the Table of equations. When discussing a recent Paper devoted entirely to similar equations, he almost gleefully declared that he "was not competent to criticize the mathematical analysis," so I assume he is not attacking the theoretical basis. And as to their practical implications, I thought I had stressed their limitations rather than their possibilities. Regular readers of the *Journal* will not, I think, accuse me of being unduly prejudiced in favour of time series correlations, yet, taking the Table of equations as a whole, in conjunction with such conditions as might normally be expected in war-time, it seems only a common-sense conclusion that these duties could not respond sufficiently to the demands of total war. Was not the purchase tax a recognition of this obvious fact? In any case, the equations, which incidentally do not preclude increased yields, were not designed to foretell war-time revenue. This must always be a difficult task. Take the year just closed. The July 1940 Budget estimated that the rise in the beer duty would increase the yield by £7½ millions, but the actual increase was over five times that amount. This may seem surprising, if one accepts Mr. Webb's theory that only the preceding year or two are relevant for Budget forecasting. But is it quite so surprising if, in conjunction with the special war-time conditions, including the diversion of purchasing power to non-rationed goods, one considers the correlation analysis of such factors as the level of prices, wages, employment and taxation since the last war? Furthermore, may not additional light on war-time yield be found in the experiences of the last war: for example, in the beer consumption month by month following the November 1914 Budget? But, as that war pursued its course, the story changed. Could any-one reading it, twenty years later, in conjunction with the story behind the equations Table, fail to see some writing on the wall? Like the original writing on the wall— about which was it not written than even "the king's wise men could not read the writing, nor make known to the king the interpretation thereof "?— its full meaning may not have been immediately apparent nor its warnings immediately fulfilled. But one may already note that, after two increases in the rate, the spirits duty Budget estimate for 1941 is lower than the actual receipts were in 1938. And money is worth less in 1941 than it was in 1938.

I regret that Mr. Crump has been prevented by illness from developing his theme.

Dr. Edelberg draws such agreeable comparisons with his own results that I hesitate to mention how substantial some of the differences might have been if our equations had covered the same period. And his contention that "imperfections" of data were unimportant in a series covering only a few years cannot be accepted in theory or practice. The lag in the beer equation was not over-looked, but was excluded because its precise character was too con-

tentious and its effect of insufficient importance in the present Paper to justify upsetting the symmetry of the equations Table.

Mr. Schwartz once again showed his unrivalled capacity for enlivening the discussion and at the same time stimulating thought. His rather startling examples reinforce my conclusions about tax burdens. But when I suggested that the increased woman's vote "portends interesting variations," I hardly imagined anything so portentous as his plan of "cosmetics for all."

Space restrictions prevent a reply to the new and interesting points raised by Mr. Allen. The cost-of-living index was used in the Paper, in spite of its many defects, simply because a "rough-and-ready indicator" of changing values, providing its character is stated and recognized, is better than none at all.

In conclusion, I would thank once again all those who took part in the discussion and threw light on some of the many intriguing problems of public finance in peace and war.

As a result of the ballot taken during the Meeting, the candidates named below were unanimously elected Fellows of the Society :—

Arthur Casley James.   Thomas William James Nicholson.

Corporate representative :

Christopher T. Saunders, *representing* The Cotton Board.

MISCELLANEA

The Relationship between Correlation Formulæ and Elliptic Functions

By M. G. Kendall

It is well known that the formulæ connecting partial and total correlations are paralleled by relations connecting the sides and angles of spherical triangles. Yule (1936) has pointed out a second group of analogies between regression coefficients and partial differentials. There is a third group, closely allied to the first, which may be worth recording. It has been known for many years that a duality exists between some of the formulæ of spherical trigonometry and certain identities connecting Jacobian elliptic functions and it is thus possible to relate the latter direct to the correlation formulæ.

Let

$$r_{12} = \operatorname{cn} u_3 \\ r_{23} = \operatorname{cn} u_1 \\ r_{13} = \operatorname{cn} u_2 \qquad . \quad . \quad . \quad . \quad . \quad (1)$$

where

$$u_1 + u_2 + u_3 = 0.$$

Then since

$$- \operatorname{dn} \{ - (u_1 + u_2) \} = - \operatorname{dn} (u_1 + u_2) = \frac{\operatorname{cn} (u_1 + u_2) - \operatorname{cn} u_1 \operatorname{cn} u_2}{\operatorname{sn} u_1 \operatorname{sn} u_2}$$

we have, from the analogous formula

$$r_{12\,3} = \frac{r_{12} - r_{23} r_{13}}{(1 - r_{23}{}^2)^{\frac{1}{2}} (1 - r_{13}{}^2)^{\frac{1}{2}}}$$

the result $- \operatorname{dn} u_3 = r_{12\,3}$ and hence, by symmetry,

$$r_{12\,3} = - \operatorname{dn} u_3 \\ r_{23\,1} = - \operatorname{dn} u_1 \\ r_{13\cdot 2} = - \operatorname{dn} u_2 \qquad . \quad . \quad . \quad . \quad . \quad (2)$$

Further, if k is the modulus of the elliptic functions

$$\operatorname{dn}^2 = 1 - k^2 \operatorname{sn}^2$$

and hence

$$k^2 = \frac{1 - \operatorname{dn}^2 u_3}{1 - \operatorname{cn}^2 u_3}$$

$$= \frac{1 - r_{12\,3}{}^2}{1 - r_{12}{}^2} \cdot \frac{1 - r_{13}{}^2}{1 - r_{13}{}^2}$$

$$= \frac{1 - R_{1(23)}{}^2}{(1 - r_{12}{}^2)(1 - r_{13}{}^2)} . \qquad . \quad . \quad . \quad (3)$$

Writing

$$R = \begin{vmatrix} 1 & r_{12} & r_{13} \\ r_{12} & 1 & r_{23} \\ r_{13} & r_{23} & 1 \end{vmatrix}$$

we have

$$1 - R_{1(23)}{}^2 = \frac{R}{1 - r_{23}{}^2}$$

and hence, from (3),

$$k^2 = \frac{R}{(1 - r_{12}{}^2)(1 - r_{23}{}^2)(1 - r_{13}{}^2)} \quad \cdots \quad (4)$$

or

$$R = k^2 \operatorname{sn}^2 u_1 \operatorname{sn}^2 u_2 \operatorname{sn}^2 u_3 \quad \cdots \cdots \quad (5)$$

Writing

$$R' = \begin{vmatrix} 1 & -r_{12\cdot3} & -r_{13\cdot2} \\ -r_{12\cdot3} & 1 & -r_{23\cdot1} \\ -r_{13\cdot2} & -r_{23\cdot1} & 1 \end{vmatrix}$$

we find, by considerations of symmetry or by direct evaluation

$$R' = k^4 \operatorname{sn}^2 u_1 \operatorname{sn}^2 u_2 \operatorname{sn}^2 u_3 \quad \cdots \cdots \quad (6)$$

and hence

$$k^2 = \frac{R'}{R} \quad \cdots \cdots \cdots \cdots \quad (7)$$

From (3) we then find

$$\begin{aligned} R_{1(23)}{}^2 &= 1 - k^2 \operatorname{sn}^2 u_2 \operatorname{sn}^2 u_3 \\ &= \operatorname{sn}^2 u_3 + \operatorname{dn}^2 u_2 \operatorname{cn}^2 u_3 \\ &= \operatorname{sn}^2 u_2 + \operatorname{cn}^2 u_2 \operatorname{dn}^2 u_3 \,. \quad \cdots \quad (8) \end{aligned}$$

and similar equations for the other two multiple correlations.

In the case of sampling from a normal population the variances also assume a simple form. We have, to order n^{-1}

$$\begin{aligned} \operatorname{var} r_{12} &= \frac{1}{n} (1 - r_{12}{}^2)^2 \\ &= \frac{1}{n} \operatorname{sn}^4 u_3 \quad \cdots \cdots \quad (9) \end{aligned}$$

$$\begin{aligned} \operatorname{var} r_{12\cdot3} &= \frac{1}{n} (1 - \operatorname{dn}^2 u_3)^2 \\ &= \frac{k^4}{n} \operatorname{sn}^4 u_3 \quad \cdots \cdots \quad (10) \end{aligned}$$

so that the standard error of the partial correlation is k^2 times that

of the total correlation.   Further, from an approximate result due
to Isserlis (1917) we have

$$\mathrm{var}\,(R_{1(23)}) = \frac{1}{n}\,(1 - R_{1(23)}{}^2)^2$$

$$= \frac{k^4}{n}\,\mathrm{sn}^4\,u_2\,\mathrm{sn}^4\,u_3$$

$$= n\,\mathrm{var}\,r_{13}\,\mathrm{var}\,r_{12\cdot 3}$$

$$= n\,\mathrm{var}\,r_{12}\,\mathrm{var}\,r_{13\cdot 2}\quad .\quad .\quad .\quad (11)$$

This formula, however, is not accurate for small n and breaks down
near $R_{1(23)} = 0$.

References

Isserlis, L. (1917), " The variation of the multiple correlation coefficient in
    samples drawn from an infinite population with normal distribution,"
    Phil. Mag., **34**, 205.
Yule, G. Udny (1936), " On a parallelism between differential coefficients and
    regression coefficients," *J. Roy. Statist. Soc.*, **99**, 770.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

CONTENTS

1.—*Field Trials : Their Lay-out and Statistical Analysis.* By John Wishart, M.A., D.Sc. Imperial Bureau of Plant Breeding and Genetics, School of Agriculture, Cambridge. 1940. $9\frac{3}{4}'' \times 7\frac{1}{4}''$. 36 pp. 2s. 6d.

About ten years ago Professor R. A. Fisher and Dr. Wishart prepared for the Imperial Bureau of Soil Science their well-known Technical Communication No. 10. This bulletin deals with the fundamental designs of field experiments and the statistical analysis of the data accruing therefrom. Later the same Bureau issued another Technical Communication (No. 35), in which Dr. Yates gives a survey of the more modern developments of field experiments. The present publication may be regarded as a modernized version of Communication No. 10.

When this communication was published the fundamental designs of Randomized Blocks and Latin Squares were regarded as the seeds of a new science. This has now grown to become an essential part of the equipment of a wider circle of experimenters. The present publication is therefore written in the style of a text-book for the beginner, and the treatment of the subject-matter is more extensive and more instructive. The reader is first introduced to the fundamental concepts of statistical analysis, such as " experimental error " and " test of significance," so that he should be able to appreciate the logic of the fundamental designs. More modern developments, such as " multiple-factor experiments," the " split-plot technique " and the more elementary aspects of " confounding," are also incorporated. The beginner is thus led up to the study of the more advanced designs given in Communication No. 35 and elsewhere.

The publication should be of great help to experimenters in any branch of agricultural science who are not professional statisticians.

H. O. H.

2. *-Tests of Significance, What they Mean and How to Use them.* By John H. Smith. Studies in Business Administration, The School of Business, The University of Chicago. London: Cambridge University Press. 1939. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. xi + 90 pp. 6s.

This study is intended to be " a survey of the common tests of significance." It is difficult to deal with this subject in a way satisfactory to all possible readers. Apparently the author does not address himself to the student-beginner. His reader is supposed to have a sound knowledge of elementary statistics, and anyone interested in the mathematical appendices should also know a good deal of calculus. Indeed, the author revels in advanced theory. For example, the complex concepts of a composite hypothesis and of an alternative hypothesis are dealt with at an unduly early stage.

Certain points of interest to the advanced student are made. It is stressed that a test of significance is, in the first place, negative, in that it rejects an hypothesis on which observed data are to be regarded as rare occurrences. The arbitrariness of the 5 per cent. and 1 per cent. level of significance is well brought out, a point which is often misunderstood. The necessity to have external evidence as an arbitrator between possible alternative hypotheses is discussed at length.

The random sampling distributions of z, F and t are derived from the χ^2 distribution. A particular point is made of using the χ^2 distribution for a sample of deviations from the population mean (assumed known). The extra degree of freedom thus gained is carried right through the discussion of the analysis of variance, where it corresponds to an extra mean square contributed by the square of the difference between sample mean and population mean. This extra mean square—which in practice is never known—is used by the author to " explain " why the total number of degrees of freedom is one less than the total number in the sample. The argument appears to be more complicated than the usual procedure of reducing the degrees of freedom in the χ^2 distribution.

The book is unsuitable for the beginner, it does not give any new results nor does it excel in the exposition of known ones.

<div align="right">H. O. H.</div>

3.— *Studies in American Demography.* By Walter F. Willcox, Professor of Economics and Statistics Emeritus in Cornell University. Ithaca, New York: Cornell University Press. 1940. $9'' \times 6''$. xxx + 556 pp. $4.50.

The author of this book will need no introduction to many Fellows of our Society; his work as Professor of Statistics in Cornell University, and his untiring labours in the interests of the American Statistical Association (of which he was President in 1912) and the International Statistical Institute, will be well known.

In the volume under review, dedicated to the memory of Continental and American pioneers in the statistical field, the results of whose early studies were to be handled and carried to a more extended perfection by later workers, Professor Willcox presents a measurably

complete survey of the development of American demography in a series of studies discussing the fundamental elements of American population problems, the reactions of economic and social relations as reflected in officially assembled statistical material, and other important matters capable of statistical treatment.

In his Preface the author observes : " By combining my published statistical studies with unpublished lecture notes, I have prepared the present volume . . . in the hope of saving some future demographer the labour of exhuming scattered contributions from professional journals here and abroad, and from Government documents, Federal and State." The twenty-four essays which the volume contains comprise twelve studies in American Census Statistics, eight in American Registration Statistics, four Miscellaneous Studies (which include biographical sketches of John Graunt — Lemuel Shattuck, Founder of the American Statistical Association— and John Shaw Billings, who laboured so tirelessly in an effort to secure uniform and complete vital registration in the several States of the American Republic), and concludes with a detailed bibliography of the more important writings of the author covering a period of approximately half a century.

Space is lacking to discuss the many-sided aspects of statistical investigation undertaken by Professor Willcox, whose criticisms of the 1890 Census in the United States and constructive suggestions for the improvement of methods led to his appointment as Chief Statistician of the Census of 1900, in which capacity he blazed the trail towards new uses of census material. His ethnological and sociological study of the Negro problem in the United States was an outstanding piece of work in the field of intensive statistical investigation, while his *Introduction to the Vital Statistics of the United States* which appears in revised form in the volume under review under the title of " The Development and Uses of American Registration Statistics," was a useful and welcome contribution for all workers who have occasion to consult the official vital statistical reports of the American Republic. These brief references concern but two of the numerous important studies from the pen of Professor Willcox. It remains to say that all the essays in the volume are packed with information, and form a striking testimony to the value and importance of the contributions made by the author, throughout a long and distinguished career, to the development of American demography.　　　　　　　　　　　　　　　　　　　　P. G. E.

4.—*Social and Economic Aspects of Swedish Population Movements 1750–1933.* By Dorothy Swaine Thomas. New York : The Macmillan Co.　xxiii + 487 pp.　$6.00.

Sweden has become the statistical laboratory for Western Europe *par excellence,* for Swedish statistics are in many respects remarkably complete and often extend farther back into the past than do those of other European countries. This is specially true of vital statistics. No other country has reliable vital statistics much before the middle of the 19th century, but Sweden's may be studied back to 1750. Vital registration in Sweden has been the task of the clergy, and

owing to the "continuous population register" method there was no need for periodic censuses. An examination of Swedish vital statistics must therefore be of great value. It should, however, be remembered that Sweden experienced industrialization rather later than Great Britain or France. Up to 1870 over 70 per cent. of the Swedish population were engaged in agriculture. When industrialization came, however, it proceeded apace. Whereas the proportion of the population engaged in agriculture had decreased by only 7·4 per cent. in the 120 years 1750–1870, the corresponding decrease in the next 60 years was 33 per cent., so that in 1930 only 39·4 per cent. of the population were classed in agricultural occupations. Even so, Sweden is more predominantly agricultural a country than Great Britain, and this fact must be borne in mind when the experience of the two countries is compared.

With the change in social structure, the married fertility rate also declined, though its fall did not become pronounced until the beginning of the present century. It is interesting to note that the time lag between the beginning of industrialization and the decline of the birth rate was approximately the same in Sweden as in Great Britain. Before 1870, though the fertility rate fluctuated, there does not appear to be any discernible trend. This, too, is in accordance with estimates made for this country.

Dr. Thomas has subjected the wealth of statistical information at her disposal to a very searching and minute analysis. In her book she gives a picture of the changing pattern of Sweden's economic and social structure and of the change in various demographic indices. It is to be regretted, however, that a good deal of space is devoted to the establishment of correlations between series indicative of economic and industrial activity and changes in the marriage and birth rates. Quite apart from the uncertainty which attaches to the interpretation of correlations between time series, such analyses would appear to be out of place in *long-term* demographic studies. Industrial and harvest fluctuations may influence internal and external migration, but it would seen that *long-term trends* in vital indices are unaffected by *cyclical* economic fluctuations.

There is not very much information about social and occupational differences in fertility, though geographic and rural–urban differentials are discussed. Nor is any mention made of Swedish population policy and the work of the Royal Commission on the falling birth rate, or of the population studies of Gunnar and Alva Myrdal. In short, the book is severely factual in character. But it contains such a wealth of information that it will probably remain the standard work in English on its subject for a long time. Perhaps some of the topics omitted in this book will be dealt with in the next volumes in the series, which are promised in the preface.   E. G.

5.—*Migration to and from the British Isles : Problems and Policies.* By R. S. Walshaw, M.A. London : Jonathan Cape. 1941. 8½″ × 5½″. 94 pp. 5s. net.

To make a comprehensive survey of migration statistics and the problems of migration in a book of 94 pages is clearly impossible.

Mr. Walshaw, however, by the skilful presentation of official statistics, succeeds in setting out the facts of migration to and from the British Isles and in providing an introduction to the broad problems of migration policies both in this country and abroad.

He shows that migration in the nineteenth century was easily provided by the " natural increase " in population, the excess of births over deaths, whereas after 1913 the natural increase so declined that between 1921 and 1930 the efflux was one-half of the increase. Furthermore, the predicted fall in the population of the British Isles makes future migration on the old scale very problematical.

It is shown that where formerly there was an outward balance of British migrants to countries outside Europe, after 1930 an inward balance had resulted. This he attributes to the world depression which made it difficult for overseas settlers to establish themselves.

Mr. Walshaw discusses this and other problems of migration policy, both for the receiving and the losing country. The receiving country desires only the enterprising, the healthy and the self-supporting, while the losing country wishes to send the unintelligent, the unhealthy and unemployed. He explains the origins of the schemes for assisted migration from the British Isles which aimed at achieving a compromise through training would-be migrants as agriculturists, financing their passage, and assisting their settlement. These schemes failed as a result of the onset of the above-mentioned depression in Empire countries. He explains, too, how the U.S.A., which had previously taken one-fifth of our emigrants, was obliged to introduce a quota system, finally cutting migration down to insignificant dimensions. Finally he shows how the reduction in migration from Eire to non-European countries, and political developments on the Continent, led to a large influx of migrants from Eire and Europe into Great Britain.

Most of the analysis is perforce qualitative and whets the appetite without providing the hearty statistical meal to which Fellows of the Society are accustomed. The book, however, is an excellent introduction to the subject and as, no doubt, that is all the author intended it to be, we can congratulate him on the achievement of his objective.   H. W. R.

6.—*Public Investment and the Trade Cycle in Great Britain.* By R. F. Bretherton, F. A. Burchardt and R. S. G. Rutherford. Oxford : Clarendon Press. 1941. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. vii + 455 pp. 30s.

Every day brings us nearer to the time when the war will be over and we shall have to face economic problems of probably greater intensity than those bequeathed to us by the last war. The transfer of the economy from a war to a peace basis will demand a close study of public expenditure from every aspect, and this lends particular importance to the work under review. The authors' main aim was to investigate the recent history and the future possibilities of public works as a means of controlling cyclical fluctuations, and they do this in a way so systematically and painstakingly as to leave little room for serious criticism.

After deciding what the trade cycle really is and how it is to be measured, they proceed to calculate the amount of public and semi-public investment, which they finally estimate at 40 to 50 per cent. of our total output of capital goods; public and semi-public works include those of central and local government bodies together with those of semi-public organizations such as railways and the Central Electricity Board. Further analysis indicates that, by accident rather than design, public investment, by its greater steadiness and its timing, tended to reduce cyclical fluctuations over the period from 1926 to 1937. But public-works policy obviously plays too important a part in our economy to be allowed to remain indefinitely the pathall of accidental forces. In one of their few flights from reality the authors venture to speculate what changes, on their assumptions, would have completely stabilized total home demand, and decide that surprisingly small alterations—at no time more than £70 millions would have done the trick. The smallness of this figure may surprise readers even more than it apparently does the authors.

An analysis of central government capital expenditure, which at present is unimportant relative to that of local authorities, shows little scope for cyclical control of civil expenditure, so long as it is restricted to the narrow sphere normally accorded to it in peace-time. It is suggested, however, that something might be done with defence expenditure, but such a policy holds out too many possibilities of danger to be readily accepted.

Local expenditure, which in the past has shown surprising instability over time and variation between areas, offers in the future possibilities of increases on roads, sewerage, and hospitals, but little hope is held out for much expansion in the important trading services or, eventually, on education or housing. This means that if expenditure is to be increased in the future to an extent consonant with effective trade-cycle control, new forms of expenditure will have to be developed. In view of the present abnormal conditions, the authors wisely refrain from suggesting any detailed plans for public works.

Throughout the book are many interesting statistical estimates, including a recalculation of the Multiplier based on fresh data and certain theoretical refinements. It is impracticable to examine here in detail their varying reliability, but it may be said that, with few exceptions, the authors take care to point out the more obvious weaknesses of data or argument. A typical and particularly interesting calculation aims at determining the proportion of public-works expenditure that returns to government funds, and calculates that a Chancellor of the Exchequer might expect to receive back, within two years, about 40 per cent. of his initial outlay. Among the various criticisms which might be offered to such calculations are that, firstly, they are based on certain assumptions regarding the Multiplier which are not universally accepted, as indeed the authors willingly admit; secondly, a method of correlating taxation with national income yielding a formula independent of tax rates can hardly be completely satisfying; and, thirdly, readers might have appreciated

fuller references or details of the methods used : those who wish to follow up the one reference to earlier work may be puzzled by the absence of title or author's name and the apparent misprint of 1939 for 1937 in the date of the publication. But these are small points, and in fact throughout the book there is a freedom from minor error remarkable in a work of this type and magnitude.

Yet, in spite of their accuracy and transparent honesty, one may wonder whether the various estimates will convert many unbelievers amongst the entrepreneurs or elsewhere. The more sceptical may at least wonder what would have happened in 1931 if the Government, instead of reducing national expenditure, had decided to increase it by the suggested figure of £70 millions. They may even wonder whether, at that time, the basic ratio $\dfrac{k'}{1-k'}$, which the authors have so carefully calculated, would have been even faintly recognizable. Yet few will be able to deny the value of many of their recommendations, such as increased central control of local expenditure, more advanced planning, the elimination of casual variations of expenditure over time and space, and, if cyclical control is agreed on and is to be fully effective, increased financial aid to local and approved semipublic bodies. This raises the question of the political factors involved, which may be decisive, but as another volume would be required to consider these factors at all adequately, it would be unfair to complain of their rather summary treatment.

This book, with its wealth of statistical tables and diagrams, will be read and studied by all serious students of public finance. But it is to be hoped it will have a much wider circle of readers, particularly among those whose decisions can substantially influence the ups and downs of national industrial activity.   C. O. G.

7.—*The Labour Cost of the World War to Great Britain, 1914–22 :* a statistical analysis. By N. B. Dearle. Carnegie Endowment for International Peace. Oxford University Press. 1940. 11″ × 8½″. ix + 260 pp. 12s.

It may seem ironic that this statistical study of the labour cost of the war of 1914–18 to Great Britain, written by Dr. Dearle under the auspices of the Carnegie Endowment for International Peace, should have appeared in the midst of the second World War. Its publication, in a briefer form than was at first intended, has, however, been accelerated in view of the renewed importance of the material and calculations assembled.

The book is a veritable mine of information on every aspect of labour and population questions for the period 1914–22. Innumerable tables are set forth on every conceivable point which bears on the effects of the war. Consequently it can be recommended as a reference book on any labour or population problem of the last war.

Every category of change in the labour force is considered, from enlistments to demobilization, from replacement by females to industrial accidents, from migration to the effects of casualty lists on the future birth-rate. In every case the analysis is careful and infinitely detailed, and Dr. Dearle distinguishes carefully the

different aspects of the problem. He has a clear idea of labour cost and, reckoning in man-years, shows how each loss or gain can be measured.

The value of the publication is heightened by the excellent policy of enumerating the sources of information used, and resolving as far as possible disagreements between sources. One error has crept into the book here, the Z8 returns of the Board of Trade being referred to throughout as the " 38 " returns.

It is perhaps unfortunate that the philosophical questions of definition do not receive more consideration. This is most striking when the author discusses the first main problem of the book, namely, what is meant by the " labour cost " of a war. Although Dr. Dearle gives most valuable warnings of the fundamental distinctions to be borne in mind, the reader is left with the suspicion that all is not well and that no precise definition has been supplied. In one sense the labour cost of a war is the labour of the whole population, since every effort, however remote from actual war production, should ideally be applied to one end, that of winning the war. Thus even the comedian who entertains the weary troops and the worn civilians is, indirectly, as much a part of the war effort as the soldier himself. But Dr. Dearle appears to take as his definition simply the loss of man-power to the forces and munitions industries, minus all the war-time gains to the industrial man-power of the nation, correcting all his gains and losses by coefficients purporting to represent the efficiency of the labour in question, *e.g.*, female labour is considered to be two-thirds as valuable as male labour.

Detailed criticism of the calculation is rendered somewhat difficult, as no explanation is given of the method of calculating the cost of transferring man-power from civilian to war industries. One obvious defect, however, is that no account whatever is taken of the different value-productivities of labour in different industries. In fact, to measure the labour cost, in Dr. Dearle's sense, of recruitment to the forces and transfer between industries it would be necessary to regard the product of the forces and munition workers as worthless. Then the labour loss is simply the amount of labour transferred from other industries weighted in proportion to the net product per person employed. This leads to the main defect of the book, the almost complete neglect of statistics of changes in distribution of labour between industries, which would have yielded much more interesting problems. This omission is apparently due to the lack of adequate data.

A particularly interesting section describes the author's measurement of the net effect of the war upon unemployment. He takes an estimate of the unemployment pattern in the pre-war trade cycle of 1907–14 as a basis from which to measure the levels during and after the war.

The final results of the book seem to show a very low cost of the war, namely, a loss of the labour of $3\frac{1}{2}$ million " equivalent average males " over the period 1914–22, and a permanent loss of 1 to $1\frac{1}{4}$ million persons, of whom about 700,000 represent average males lost to the labour supply. When one bears in mind that at July

1914 there were about 14½ million occupied males and 5½ million occupied females, quite apart from about 11 million unoccupied females, this cost seems extremely low. It seems hardly conceivable that over the period 1914-22 only about 15 per cent. of the national man-power was absorbed in working the war machine.

However, as we have seen, much depends on the definitions chosen as to the resulting labour cost of the war, and within the limits of Dr. Dearle's definitions his result is undoubtedly correct and certainly most interesting. Perhaps the main value of the book is not so much the end value of the calculation, as the mode of calculation and the assembled and derived data. Dr. Dearle has given us the extremely valuable results of much arduous work, and his book will remain an indispensable guide and source of data to all future workers in this field.   H. W. R.

8.—*Social Aspects of Crime in England between the Wars*. By Dr. Hermann Mannheim. London: Allen and Unwin. 1940. 8½″ × 5½″. 382 pp. 18s.

The author set himself the problem of studying systematically the causal factors of crime and the social aspects of crime in the period after 1919. The years after the Great War were years of immense change in this country: economic and social changes of a revolutionary character took place in a comparatively short time with hardly any comment from the victims of these changes. Inevitably these changes influenced the crime pattern, and the author's task was to study the problems arising out of these circumstances. One can understand the magnitude of the job by reading the present book. With the advent of the present war the work was necessarily disturbed, but at the same time it was complete, because now it gives a record of events between these two Great Wars which will be useful for comparative purposes later.

Any study of this nature means a study of statistical material, *inter alia*. Dr. Mannheim devotes about a quarter of the book to the Structure and Interpretation of the Criminal Statistics of England and Wales. The Home Office publishes annually a book entitled *Criminal Statistics*, and it is the content of this publication which furnishes us with most of our factual information about crime and criminals. The author takes us through this blue book in a very interesting manner. Sometimes we despair because we feel that he has shown conclusively that the figures which he is discussing do not mean what they appear to mean; at other times we are relieved because we realize that in spite of apparently insuperable difficulties, some of the figures do present an accurate picture. One of the major difficulties in the recording of criminal statistics is their dual nature. The officials try to give us two lots of information: one about crime and the other about criminals. Many of us are detective-story readers, and some of us are detective-story writers, so we have a natural interest in the frequency of crime and the number of criminals. We know, from our fiction reading, that many crimes are officially known to the police, and at the same time that many criminals may be unofficially known, but are not recorded as such,

and so escape statistical recognition. We have to remember also that the output of criminal statistics is not the main function of police activity in this country. The incidence of crime may be compared with the incidence of disease. We often talk about a " crime wave " in the same way as we talk about an " epidemic." The question remains whether the records of crime are as complete as the records of cases of a particular disease. A comparison between records of two towns shows striking differences between the occurrence of certain offences. One is inevitably led to the conclusion that local differences may be due to differences between local administrations. Further, the size of the police force in any locality is determined by other factors than the amount of crime, consequently these other factors will have an influence on the total amount of crime recorded there. One realizes, after reading Dr. Mannheim on the English criminal statistics, that one has to be very careful in the interpretation of these figures.

In the remaining part of the book the author compares the changes in records of crime with various other records, unemployment, etc. He finds difficulties in connecting unemployment with crime, and concludes (p. 151) " where unemployment and crime both stand at a high water-mark, it can safely be assumed that the latter is largely due to the former; where the crime figures remain low in spite of much unemployment, certain factors are obviously at work which counterbalance its evil effects. In other words, the fact that there is often much unemployment with little crime does not prove that, wherever we find a great deal of both, crime has not resulted from unemployment." One feels that the author is in the fortunate position of that person tossing a coin for drinks, who first says, " Heads I win, tails you lose."

There is an interesting chapter on crimes resulting from modern methods of " Business Administration," insurance frauds, larceny from automatic machines and meters, hire-purchase offences, etc. There is a long chapter on an investigation into the records of Borstal boys and girls, illustrated by particulars of many " cases." This investigation is not mainly of a statistical character.

The whole book is very readable, and shows how deeply the author has delved into his subject. For the sociologist who wishes to get an insight into recent criminal history it will be valuable, for the statistician the main interest will lie in the chapters devoted to an analysis of the content of the " criminal statistics."   E. C. R.

STATISTICAL NOTES

1. British Official Statistics

THERE was but little change in the general level of *Wholesale Prices* during the four months May to August 1941. The increase during the period was only about one and a half per cent., according to the Board of Trade index-numbers, which stood at 150·9 for April and 153·2 for August 1941. (Average for 1930 = 100.) Food prices advanced about one and a quarter per cent. and prices of industrial materials and manufactures about 1·7 per cent. It must be borne in mind, however, that this comparative stationariness of the index-number is to a great extent due to the fact that the prices of a large number of articles of food and of other products, are fixed or controlled by the Government, which also in many cases restricts or regulates the supply. And, as stated in the *Board of Trade Journal,* " In cases where the Government, since the outbreak of war, has bought a commodity at one price and sold it at a lower one (*e.g.*, home produced meat) the subsidized price is the one used for the index." As has been stated previously, the market quotations of other articles are in many cases apt to be more or less nominal at times, by reason of the fact that supplies are not always freely forthcoming for delivery.

Of the eleven groups into which the commodities included in the index-number are divided, only two showed any decline—viz., that for meat, fish and eggs, where there was a decrease of 4·7 per cent., chiefly due to a fall in the prices of eggs, and that for non-ferrous metals, where a fall of 0·4 per cent. was due to a slight decline in prices of tin. The principal increases were in the group of cereals (8·8 per cent.), and that of textiles other than cotton and wool (9·2 per cent.). Coal prices advanced 3·9 per cent., basic materials other than fuel 2·1 per cent. and cotton 2·6 per cent.

Compared with prices in August 1940, there was in August 1941 an overall increase of 9·4 per cent., materials and manufactures advancing 10·2 per cent. and food products 7·6 per cent. All groups showed some advance, which was greatest in textiles other than cotton and wool (18·2 per cent.) coal (15·4 per cent.) and food products other than cereals, meat, fish, etc. (14·7 per cent.). Prices of non-ferrous metals were almost stationary, but the prices of all these, except that of tin, are controlled.

The Board of Trade index-numbers of wholesale prices for the latest five months of 1941 are given below, together with the increases in August 1941 over August 1940 and 1939.

(Average of prices in 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
April 1941 ...	144·0	154·2	150·9	164·7	163·7	147·6	138·2
May ,, ...	144·4	154·7	151·3	166·3	164·0	147·8	138·2
June ,, ...	145·1	156·1	152·4	167·0	165·6	148·5	139·3
July ,, ...	146·3	156·5	153·2	167·7	165·8	148·6	140·0
Aug. ,, ...	145·8	156·8	153·2	168·1	165·8	148·9	140·3
Aug. 1940 ...	*135·5*	*142·3*	*140·1*	*148·9*	*153·9*	*136·3*	*127·6*
,, *1939* ...	*90·4*	*102·2*	*98·1*	*94·5*	*104·0*	*108·7*	*104·1*
Percentage increase in Aug. 1941 over—							
Aug. 1940 ...	7·6	10·2	9·4	12·9	7·7	9·2	10·0
,, 1939 ...	61·3	53·4	56·2	77·9	59·4	37·0	34·8

The figures for certain other British index-numbers of wholesale prices and the index-number of wholesale prices prepared by the U.S. Bureau of Labour are given below.

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866–77 = 100)	*The Times* (1913 = 100)	United States Bureau of Labor (1926 = 100)*
Apr. 1941 ...	150·9	104·3	141·1	169·6	82·8
May ,, ...	151·3	104·9	143·5	169·9	84·4
June ,, ...	152·4	104·8	144·4	170·2	86·9
July ,, ...	153·2	105·4	145·3	168·9	88·2
Aug. ,, ...	153·2	106·4	145·1	171·4	89·8
Aug. 1940 ...	*140·1*	*98·3*	*131·5*	*157·5*	*77·2*
,, *1939* ...	*98·1*	*70·3*	*90·4*	*114·5*	*80·5*

* Mean of weekly figures.

It will be seen that the course of wholesale prices in the United States has been markedly different from that in the United Kingdom. Prices in the former country certainly rose to some extent during the first four months of the war (the index-number advancing from 80·5 to 84·3), but during the first nine months of 1940 prices gradually fell, and at the end of September the index-number was at 77·7. From that date prices have gradually risen, until at the end of August 1941 the number stood at 90·6. The advance has apparently been most marked in the prices of food. The Bank of England index-number of comparative prices in the United Kingdom and the United States of fifteen primary products shows since August 19th, 1939, a rise of 61½ per cent. in the United States, compared with 38·5 per cent. in Great Britain in the prices of the six articles constituting

the food group (wheat, maize, sugar, beef, cotton-seed, oil, tea). As regards the metal group (pig iron, copper, lead, tin), the United States price shows a much smaller advance, 10·7 per cent. compared with 26·3 per cent. In other industrial materials there would appear to be little difference in the percentage advances in the two countries. For all the fifteen primary commodities prices in the United States actually show a greater increase over the two years than prices in Great Britain (40·8 per cent. compared with 36·6 per cent.), but some of the commodities are subsidized in Great Britain.

During the four months May to August 1941 there was some decline in the general level of *retail prices* of food and some advance in the prices of other articles, of a kind usually consumed by working-class families. According to the index-number prepared by the Ministry of Labour and National Service, food prices showed a decline from 171 at the beginning of May 1941 to 166 at the beginning of September, or nearly 3 per cent. (prices at July 1914 = 100). The decline since May has been due to a considerable reduction in the prices of fish and to smaller reductions in those of eggs and potatoes. There was during the period some advance in milk prices in certain districts.

The advance during the first two years of the war has therefore been about 20 per cent. There have been more considerable advances in the prices of other articles; clothing prices have risen 84 per cent., fuel and light nearly 25 per cent. and other miscellaneous articles 28 per cent., with the result that the general index-number has advanced over the two years about 28 per cent. (155 to 199). The Ministry of Labour and National Service estimates that of the advance of 44 points, about 2¾ points are due to the increases since September 1939 in the taxes on sugar, tobacco and cigarettes, and approximately 5½ points to increases resulting from the purchase tax.

The index-numbers for the period May 1st, 1941, to September 1st, 1941, are given below, the average prices at July 1914 being taken as 100.

Date			Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
May 1st, 1941		...	171	164	365	226	226	200
,, 31st, ,,		...	170	164	370	226	227	200
July 1st, ,,		...	167	164	375	228	227	199
Aug. 1st, ,,		...	167	164	380	228	229	199
Sept. 1st, ,,		...	166	164	380–385	228	230	199
Sept. 1st, 1940		...	*166*	*164*	*295*	*212*	*219*	*187*
,, ,, *1939*		..	*138*	*162*	*205–210*	*180–185*	*180*	*155*

At the end of the first two years of the war it is of interest to compare the progress of the advance in wholesale prices during the period, always bearing in mind what has been said above as to governmental control, both as regards prices and supply. The advance was most rapid and considerable (24·7 per cent.) during the first four months of the war. During that period cereals advanced over 54 per cent. and cotton over 50 per cent., wool nearly 28 per cent. and other textiles 38 per cent. The groups of commodities showing the smallest increases in prices—coal 8·6 per cent., iron and steel 10·3 per cent., non-ferrous metals 13·3 per cent. and chemicals 13·4 per cent.—were for the most part from the start controlled either by the fixing of prices or the regulation of supplies or by both methods. During 1940 prices generally continued to advance but less rapidly, and not to the same extent for any one group. The most noticeable increases were in the controlled commodities, coal, iron and steel and wool, the prices for which were advanced 19·5, 26·6 and 27·3 per cent., respectively. There were also considerable increases in the prices of timber and of paper-making materials. In contrast to these considerable increases in 1939 and 1940, during the first eight months of the present year the general price level showed comparatively very little increase (3·1 per cent.), although cotton advanced 9·4 per cent. and other textiles (excluding wool)

Group	Increase of—			
	Dec. 1939 over Aug. 1939	Dec. 1940 over Dec 1939	Aug. 1941 over Dec. 1940	Aug. 1941 over Aug. 1939
I. Cereals	54·2	13·9	2·5	80·0
II. Meat, Fish and Eggs ...	24·4	15·1	3·7 *	38·1
III. Other Food and Tobacco ...	21 2	33·6	3·0	66·9
Total—Food and Tobacco	30·6	22·4	0·9	61·3
IV. Coal	8 6	19·5	6·4	38·1
V. Iron and Steel	10·3	26·6	0·9	40·9
VI. Non-ferrous Metals	13 3	8·1	0·3	23·0
VII. Cotton	50·4	4·7	9·4	72·4
VIII. Wool	27·9	27·3	2·2	66·4
IX. Other Textiles	37·9	7·9	12·4	67·3
X. Chemicals and Oils	13·4	16·2	6·0	37·5
XI. Miscellaneous	30·8	28·4	5·2	76·7
Total—Materials and Manufactures	21·6	21·0	4·3	53 4
Total—All Articles	24·7	21·5	3·1	56·2
Industrial Materials (excluding Fuels)—				
Basic Materials	42·9	17·2	6·3	77·9
Intermediate Products	20·2	28·6	3·2	59·4
Manufactured Articles	12·2	18·3	3·2	37·0
Building Materials	6·0	20·4	5·7	34·8

* Decrease.

12·4 per cent. The food group for meat, fish and eggs actually declined 3·7 per cent.. due to lower prices being fixed for fish and eggs. It looks as if we may be entering on a period of stabilized prices, to a great extent, of course, artificially stabilized, and certainly not evidential of the equilibrium of supply and demand. It may be expected that any change in actual costs will be met to a large extent by variations in subsidization.

The index-number of the cost of living as prepared by the Ministry of Labour has followed a course somewhat similar to that of the Board of Trade's wholesale prices index. In the first four months of the war it rose 12·3 per cent., in the year 1940 it rose 12·6 per cent. and during the first eight months of the present year only 1·5 per cent. The index-number for food advanced 13·8 per cent. from September to December 1939, 9·6 per cent. from January to December 1940 and showed a decline of 3·5 per cent. for the first eight months of 1941.

The percentage increases in the Board of Trade index-number for the various groups of commodities during the periods specified are set out in Table on p. 297.

Unemployment continued to decline during the three months between May 12th and August 11th, 1941, and the number of persons remaining on the registers of the employment offices of the Ministry of Labour in Great Britain at the latter date was 270,289, compared with 368,988 at May 12th, a reduction of 98,699. There was a continuous fall over the three months in the number of men and women out of work, but the number of boys and girls under 18 showed an increase in August, mainly due to the registration of school-leavers at the end of the school year. Of the 98,737 men wholly unemployed who were on the registers in August, 32,345 had been classified by interviewing panels as unsuitable for ordinary industrial work. Of the 103,644 women and girls, 3,623 had been classified as not suitable for normal full-time employment and 4,154 classified as "unable for good cause to transfer to another area, although employment was not likely to be available locally." The high proportion of women on the registers continues. There is, of course, an acute and increasing demand for men and women in all war industries, and with the de-reservation of men in many occupations the shortage of labour is bound to increase. Compared with August 1940 there was a decrease in the number unemployed of 529,163. In the month before the war the number on the registers was 1,231,692.

The table below gives the number of insured and uninsured workpeople 14 years of age and over on the registers of the Employment Offices of the Ministry of Labour and National Service in Great Britain.

Date	Wholly Un-employed	Tem-porarily Stopped	Persons normally in Casual Employ-ment	Total	Males	Females
May 12th, 1941 ...	290,312	65,744	12,932	368,988	181,823	187,165
June 16th, ,, ...	243,656	47,733	10,550	301,939	149,411	152,528
July 14th, ,, ...	219,577	46,027	11,676	277,280	145,529	131,751
Aug. 11th, ,, ...	219,771	37,950	12,568	270,289	143,675	126,614
Aug. 12th, 1940 ...	*613,156*	*154,380*	*31,916*	*799,452*	*439,513*	*359,939*
,, *14th, 1939* ...	*968,108*	*211,978*	*51,606*	*1,231,692*	*947,099*	*284,593*

The total number of boys and girls 14 years of age and under 18 on the registers in Great Britain at August 11th, 1941, was 40,415 (22,566 girls and 17,849 boys). Of these 23,023 (12,466 girls and 10,557 boys) were under 16. Only 229 girls and 29 boys were attending authorized courses of instruction in August, as compared with 448 girls and 268 boys in July.

During the three months June to August 1941 the *rates of wages* of workpeople were increased to the extent of £480,000 per week, and since the commencement of the war the net total of advances granted have amounted to nearly five and a half million pounds. Advances granted to domestic servants, agricultural labourers, shop assistants and clerks and Government employees are not included in the above total, nor does it include any increased earnings due to overtime.

2. OTHER STATISTICS

According to the record of *retail sales* prepared by the Bank of England in conjunction with various retail distributors' Associations and Cooperative Societies, there was a decline in the average daily value of the sales during the first seven months of the trading year (February to August) of 2·5 per cent. compared with the corresponding period of 1940. Food prices showed a decline of 2·1 per cent. and commodities other than food of 3·0 per cent. The monthly change as compared with those of the same month in 1940 showed considerable variation, and there were advances in February (2·9 per cent.), April (1·7 per cent.) and June (0·6 per cent.). The decrease was greatest in July, when food sales dropped 6·7 per cent. and the sales of other goods 15·9 per cent. This decline was principally

due to rationing of clothes and the absence to a considerable extent of the usual summer sales. In view of the general advance in the prices of most commodities, in addition to the incidence of the purchase tax, the figures point to a very considerable decline in the volume of sales.

The value of wholesale trading in textiles as shown by the index-number prepared by the Bank of England and the Wholesale Textile Association declined in each of the first eight months of 1941 except in June. The improvement in June was nearly 26 per cent. above the figure of June 1940, but was merely a " flash in the pan," owing to the rationing of clothes. In July the values again declined as compared with a year ago, and in August the decline amounted to 31 per cent. There was a slight increase over the period in the export values, but these to-day form but a small portion of the trade. The mean index-number for the first eight months of 1941 was 95, compared with 114 for the corresponding period of 1940; home sales stood at 95 and 116, and export sales at 97 and 92 (average monthly sales in 1937 = 100).

De Svenska Privat-Anställda * is the title of an elaborate investigation into the economic and social conditions of Swedish non-manual workers in private employment, which was undertaken in 1936.

The author is Dr. Fritz Croner, a professor of the University of Lund, where the work was carried out in the Institute of Statistics, under Professor Knud Wicksell, the Director, as an experiment in practical and theoretical sociology. The forms sent out contained 50 questions covering 13 subjects : personal particulars; education; employment since leaving school; salary during the period; conditions of contract; pension; working homes; farming; housing; trade union; if improvements in conditions were suggested. In all, 38,000 of these questionnaires were sent out to trade unions and private persons and the investigation was advertised in trade union journals and in the daily press. The number of replies returned was 7,726, of which 7,337 were suitable for use. The resulting material was fairly representative of the different occupational groups included in the enquiry. The main object was to determine the relative economic status of the various categories, and it was found that the

* *De Svenska Privat-Anställda : en Sociologisk Studie.* Dr. Fritz Croner. Stockholm : Kooperativa Forbundets Bokforing. 1939. 9¾ × 6¾. 474 pp. Kr. 12.

median annual salaries for men in the various groups were as
follows :—

					Kr.
Managers	...	...	...	...	12,500
Technical administrators...	...		...	...	3,449
Labour managers	...	...	...	...	5,441
Commercial administrators		...		...	3,628
Porters	...	...	...	...	2,644
Warehouse personnel	...		...	...	3,000
Shop hands	...	...	...	...	2,621
Pharmacists	...	...	...	...	8,043

The median salary for all groups was 5,595 kr. per annum.
Endeavours to establish a correlation between salary and general
education proved unsuccessful, but a high correlation was found to
exist between salary and professional education.

The methods employed by the investigators are fully described in
the book, and the results are given in great detail, with many
tables, charts, and ingeniously contrived diagrams. The study
should be very valuable to those undertaking similar investigations
in other countries.

CURRENT NOTES

THE first number of a new economic periodical has reached us from Spain—*Anales de Economia*, which emanates from the Instituto de Economia Sancho de Moncada of Madrid. The publication (in March 1941) marked the first anniversary of the Consejo Superior de Investigaciones Cientificas of the Institute, which was formed for the strictly scientific study of economic problems relating to Spain and to work out constructive solutions appropriate to the special conditions of the country. The *Anales* embody the results of their year's labours. The first article, by H. P. Eguilaz, gives a detailed account of the monetary vicissitudes during the Spanish War, the next, by German Bernacer, is an elaborate discussion, running to nearly 40 pages, of monetary and market theory, from the classic equations to those of Irving Fisher, Keynes, D. H. Robertson, and the author himself, whose work on the subject has received some attention from Mr. Robertson. This is followed by " El indicador del mercado," a study of price formation by A. Alvarez, and a discussion on the fertility of the land and the laws of minimum fertility and decreasing returns, by Manuel de Torres. The number further contains some textual reproductions of relevant discourses and decrees, and several reviews of books, among which we note R. G. D. Allen's *Mathematical Statistics*.

THE Council desire to record their great regret at the death of their valued colleague Mr. M. S. Birkett, which occurred suddenly in a nursing home on August 6th. Mr. Birkett was a life member of the Society, elected in 1917; he served on the Council from 1929 to 1933 and from 1934 to 1937, and was again elected a member in June, 1941. He read two papers before the Society, both dealing with the iron and steel industry, with which he had been intimately connected since 1919, when he was appointed Secretary to the National Federation of Iron and Steel Manufacturers, now transformed into the British Iron and Steel Federation. Apart from these specific services, Mr. Birkett was always ready to assist the Society with his expert knowledge, and grudged no time or trouble. Fellows who came in contact with him will join in the Council's appreciation of his sterling and lovable qualities and in their deep sense of loss.

THE Society has been notified by the Société Hongroise de Statistique of the death on March 31st of the veteran statistician, their one-time President, M. Gustave Thirring. In his long and industrious life M. Thirring occupied many posts, including that of Director of Statistics of the city of Budapest, and Professor at its University. At the time of his death he was a Conseilleur Supérieur of the Hungarian Government, a member of the Académie Hongroise des Sciences, and an honorary member of the Deutsche Statistische Gesellschaft, the American Statistical Association, and the International Institute of Statistics, to whose *Proccedings* he made many contributions. Many Fellows will remember having seen him, with his brother, M. Louis Thirring, at the London meeting of the Institute in 1934.

STATISTICAL AND ECONOMIC ARTICLES IN
RECENT PERIODICALS

UNITED KINGDOM—

The Banker—

July 1941—International trade in the post-war world : *P. Bareau.*

August 1941—Eclipse of the merchant banker : *P. Bareau.*

September 1941—Economic incentive in a war economy : *T. Balogh.*

October 1941—Germany's economic mobilization.
German war finance : *H. W. Singer.* Inflation, wages and rationing : *M. Kalecki.* Banking and finance in the Soviet Union : *R. B. Reddaway.*

Bankers' Magazine—

August 1941—The June bank statements. The U.S.A.'s favourable balance and the logic of Lease and Lend.

September 1941—Two years of war : U.S. Loan to Britain.

Economica—

May 1941—Consumption, investment and national expenditure in wartime : *A. Maizels.* The inaccuracy of expectations : *J. C. R. Dow.*

August 1941—Economic incentive in wartime : *F. W. Paish.* The taxation of war wealth : *F. Benham.* Rationing of purchasing power to restrict consumption : *J. J. Polak.*

Eugenics Review, July 1941—A note on the intellectual differences of the sexes : *B. S. Bramwell.* War and the birth rate : *R. M. Titmuss.*

Manchester School of Economic and Social Studies, April 1941—
Saving and the rate of interest in war-time : *J. R. Hicks.* Agriculture in wartime : *J. Stafford.* Economic Progress : *S. Kuznets.* The failure of the pigs marketing scheme : *P. T. Bauer.*

Oxford Institute of Statistics, Bulletin—

August 11, 1941, No. 11—The trend of wages : *J. Nicholson.* The two stamp plan, a new method of distribution : *S. Moos.*

August 30, 1941, No. 12—Towards comprehensive rationing : *M. Kalecki.* German manpower policy : *T. Balogh* and *K. Mandelbaum.*

Supplement No. 1—Working class budgets and the cost of living index.

September 20, 1941, No. 13—War-time changes in employment and the wage bill : *M. Kalecki.* The Trade Union Congress and inflation : *F. Burchardt.*

UNITED KINGDOM—*Contd.*

Review of Economic Studies, June 1941—Earnings and prices, 1904, 1914, 1937–8 : *A. L. Bowley.* Rationing in the U.S.S.R. : *E. M. Chossudowsky.* Rationing and the cost of living index : *N. Kaldor.*

Royal Society of Arts, Journal of, September 19, 1941—Partnership on the Scale of Modern Industry : *J. Spedan Lewis.*

Scottish Journal of Agriculture, July 1941—Agriculture and the war machine : *Sir E. J. Russell, F.R.S.* The future of British food production : *Sir A. D. Hall, K.C.B., F.R.S.*

Sociological Review, July–October 1940, Nos. 3 and 4—Recent changes in the trend and distribution of our school population and the effects on education : *R. S. Walshaw.* A Regional analysis of strikes, 1921–1936 : *M. Daly* and *Enid Atkinson.* The measurement of the relation between economic conditions and malnutrition : *J. Inman.*

AUSTRALIA—

Economic Record, June 1941—Federal and State Income Tax : *H. S. Carslaw.* New developments in Australia's war economy : *E. R. Walker* and *R. M. Beecroft.* Recent New Zealand data regarding the incomes of individuals : *E. P. Neale.*

AFRICA—

South African Journal of Economics, March 1941—Economics of exchange in a primitive society : *Eileen J. Krige.* An analysis of income and expenditure of Indian families in the Clairwood area of Durban : *P. C. Sykes.* The Union's balance of external payments : A Comment : *G. F. Thirlby.*

UNITED STATES—

American Economic Review, June 1941—Multiplier analysis of armament expenditure : *R. V. Rosa.* China's foreign exchange problems : *Ta-Chung Liu.* Residual item in balance of payments : *G. W. Mckinley.*

American Statistical Association, Journal of the, June 1941—The meaning of unemployment statistics : *Aryness Joy.* Dynamics of labour supply : *H. B. Myers.* Wholesale price indexes : *F. McIntyre.* Cost of living indexes : *R. A. Sayre.* Price indexes as viewed from the standpoint of the National Defense program : *M. Taitel.* Observation on correlation analysis : *A. H. Mowbray.* The validity and significance of male net reproduction rates : *R. J. Myres.* The relation between the design of an experiment and the analysis of variance : *A. E. Brandt.* Some practical uses of hyperbolic grids : *H. G. Smith.*

UNITED STATES—*Contd.*

Annals of Mathematical Statistics, June 1941—The cyclic effects of linear graduations persisting in the differences of the graduated values : *E. L. Dodd.* On the distribution of Wilks' statistic for testing the independence of several groups of variates : *A. Wald* and *R. J. Brookner.* The mean square successive difference : *J. von Neumann, R. H. Kent, H. R. Bellinson,* and *B. I. Hart.* The return period of flood flows : *E. J. Gumbel.* On the foundations of probability and statistics : *R. von Mises.* Probability as measure : *J. L. Doob.*

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Political Economy, Journal of, June 1941—A discussion on methods in economics : *J. Marschak.* The demand for money and the concept of income velocity : *W. S. Salant.* Professor Hicks on value and capital : *Oskar Morgenstern.*

Quarterly Journal of Economics—
 May 1941—The food problem in the German war economy : *F. Strauss.* A reconsideration of the theory of exploitation : *G. F. Bloom.* Monetary policy and the theory of interest · *Harold M. Somers.*
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 May 1941—Defense financing and inflation : Some comments on Professor Hansen's article. The business cycle, interest and money : A methodological approach : *F. H. Knight.* Controversial aspects of unemployment estimates in the Ui States : *W. S. Woytinsky.*

UNITED STATES—*Contd.*

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SWEDEN—

Anglo-Swedish Review—

August 1941—The economic situation in Sweden.
September 1941—Swedish Political Survey.

SWITZERLAND-

Zeitschrift für schweizerische Statistik und Volkswirtschaft—

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INTERNATIONAL—

International Labour Review, September 1941—The War structure of the British Engineering Industry : *G. W. Thomson.*

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part II, 1941, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom

Select Committee on National Expenditure, Session 1940–41. Reports : 16th. 8 pp. 2d. 17th. 4 pp. 1d. London : H.M.S.O., 1941. 9¼″ × 6″. 2 parts.

Trade, Board of. Concentration of production : explanatory memorandum. London : H.M.S.O., 1941. 9¾″ × 6″. 4 pp. 1d.

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Dock labour in the Port of Greenock. . . . Edinburgh : H.M.S.O., 1941. 9¼″ × 6″. 12 pp. 2d.

Treasury.
Agreement between the government of the United Kingdom . . . and Reconstruction Finance Corporation, dated July 21, 1941. London : H.M.S.O., 1941. Cmd. 6295. 9¼″ × 6″. 20 pp. 4d.
Draft regulations proposed to be made by the Treasury under Clause 1(2) of the Financial Powers (U.S.A.) Securities Bill. London : H.M.S.O., 1941. Cmd. 6296. 9¼″ × 6″. 6 pp. 1d.
Votes of credit 1941–42 : statement of services to be provided for in votes of credit, 1941–42. London : H.M.S.O., 1941. 9¼″ × 6″. 64 pp. 1s.

Scotland. Department of Agriculture. Scottish journal of agriculture. Vol. xxiii, No. 1, July 1940 to Vol. xxiii, No. 3, July 1941. Edinburgh : H.M.S.O., 1940–41. 9¼″ × 6″. 3 parts. 1s. ea.

(b) British Empire

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Mexico—

Secretaria de la Economia Nacional. Direccion General de Estadistica. 2o censo industrial de los Estados Unidos Mexicanos. Materias primas consumidas. Mexico, D.F.: 1941. 9″ × 6¾″. 101 pp.

Mozambique

Repartiçao Técnica de Estatistica. Apenso ao Boletim económico e estatístico, Ano v, jan–junho 1938. . . . Boletim mensal das observações meteorológicas feitas nos postas da colónia. Lourenço Marques: 1940. 11″ × 8½″. 207 pp.

(d) **International**

International Labour Office—

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Actuarial Society of America and The Association of Life Insurance Medical Directors. Supplement to Blood pressure study. New York: 1941. 11″ × 8½″. 22 pp. (From the Joint Committee on Mortality.)

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Townroe (B. S.). The building of a new Britain : the building industries' responsibility for reconstruction. London : Building Industries National Council, 1941. 9″ × 6″. 16 pp.

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JOURNAL

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DIPHTHERIA AND SCARLET FEVER INCIDENCE DURING THE DISPERSAL OF 1939-40

By PERCY STOCKS, M.A., M.D.

AT the beginning of September 1939, owing to the outbreak of war some 735,000 school children were removed, under arrangements made by the Ministry of Health and Board of Education, from densely populated and dangerous areas and dispersed over many hundreds of towns and rural districts. The administrative areas from which these movements were organized were styled "Evacuation" areas, and those to which the children were moved "Reception" areas, the unaffected districts being "Neutral" areas. The numbers of school children moved under this scheme amounted to 25·5 per cent. of the estimated total of resident children aged 0–15 in the evacuation areas and 25·7 per cent. of the total resident in the reception areas.

It was anticipated by many epidemiologists that dispersal on such an unprecedented scale of school children from the crowded industrial towns, where exposure to infection from the epidemic diseases of childhood is almost unavoidable, the average age of attack low and the average immunity level attained by a given age presumed to be high, into districts where this level is lower might result during the autumn and winter of 1939 in an unusual incidence of epidemic diseases amongst the native children of the reception areas. It has been said that no such thing happened, but that there is as yet no agreement on the evidence is shown in the following quotation from the report to the Fabian Society on the working of the evacuation Scheme.* Referring to the epidemic position in the early part of 1940, E. G. Baxter states : " There is, however, no evidence as to the extent to which these epidemics have been connected with evacuation. . . . Nor can we say how these epidemic diseases have struck among the population of the reception areas, though

* *Evacuation Survey*, Edited by R. Padley and Margaret Cole, London, 1940, p. 95.

reports, again drawn from general observation, suggest quite definitely that the country children have suffered far more then the evacuees, and this may suggest that the gloomy prophecies as to the medical effects of mingling populations possessing different kinds of resistance to disease are, to a very small extent, coming true." The trend of incidence in the country as a whole is affected by cyclical changes which affect the notification rates very considerably, apart from wars and the disturbances caused thereby. Furthermore, the re-duction of population density and widespread school closure in the evacuation towns might so reduce incidence there as to mask the effect on the national rates of increases occurring in the reception areas. No satisfactory answer can be given to the question how the dispersal affected the incidence of infectious diseases in children, without dividing the country into all its component areas, reas-sembling them into evacuation, neutral and reception groups, and comparing the trends of quarterly notifications in these groups with due regard to the changing populations at risk. In the present paper this has been done first for two diseases, diphtheria and scarlet fever, leaving other diseases to be studied subsequently. No dis-tinction between native and billeted children has been possible amongst the cases notified from reception areas, for this information is only available locally, if at all, and consequently only the total incidence in the mixed population of such areas can be calculated directly, though certain general inferences can be drawn from the statistics as to which group of children was affected. The facts must first be established before theories can be formulated, and the main purpose has been to present the national data which are available in such a form that epidemiologists can study them and, if it seems desirable, carry out further investigations later into the records of particular groups of reception areas.

A few areas which had been scheduled in advance for reception under the scheme did not receive any children in 1939, and for the purposes of this study they have been included with the neutral areas. The estimated population of children at the school ages 5–14 at the middle of 1939 in England and Wales was about $5\frac{1}{4}$ millions. the ratio of school children dispersed under the official arrangements to this total being 14 per cent. In addition to the children dispersed under the Ministry's scheme, large numbers were moved privately or accompanied their parents or relatives to other homes. It is estimated that, after allowing for changes in the civilian population caused by enlistment, natural increase and migration, about one-third of the persons who moved from evacua-tion to reception areas independently of the official scheme for school children consisted of children under 15.

children to the morbidity experience of the reception areas in the post-dispersal period is very ingenious, but is his conclusion justified that the major increase, roughly 60 per cent., occurred amongst the native children? It may well be that the reverse occurred. Many children were transferred to reception areas in which the environment, if represented by the number of persons per house and by the increased herding in small schools, may have been possibly worse than that which they had left in the large cities. Under such conditions it may very well be that it was the migrant children who experienced the increased incidence from infection. Of course, the point can only be definitely settled by the local Medical Officers of Health making the appropriate differentiation in their returns. Dr. Stocks finds that the disturbance in the rates in the post-dispersal period was a temporary one, and that the incidence soon reverted to its normal level. I do not think we can conclude from this that the danger has been avoided. There is a certain degree of periodicity of some of the infectious diseases. It may well be that the crest of the period has not yet arrived and, as a consequence, the effects of evacuation to the reception areas are yet to be experienced.

Apart from this question of an increased incidence, there is one consideration of very great importance, to which Dr. Stocks refers on p. 326—the possibility of the importation of a particular type of organism. This is true of diphtheria, and the recent history of that disease in Liverpool is instructive. In 1937 34 per cent. of the children admitted to hospital with diphtheria had the *gravis* strain; in the subsequent years the proportion increased, and in 1940 it was no less than 71 per cent. It follows from this that children evacuated from Liverpool will introduce this particular type of organism. But in reference to this possibility I do not quite follow Dr. Stocks, when he speaks of a native community being in " equilibrium with a particular type." What is the bacteriological justification for this statement? Is not a child either immune from or susceptible to diphtheria? Does not active immunization protect against all three types? Dr. Stocks postulates in (1) on p. 325 certain conditions under which the disease will spread amongst native children. Why do not these same conditions apply with equal force to (3)? The introduction into a " virgin " population of 500 carriers of a specific type of the bacillus is, I should think, more likely to cause an epidemic than would the ingress of 50 carriers. Confirmation of this is available in the experience of the less urbanized areas, because the maximal incidence of diphtheria did not occur until the proportion of officially billeted to native children reached 59 per cent.

In conclusion, I should very much like to congratulate Dr. Stocks on this brilliant piece of research, which must have entailed very heavy work, and I shall look forward eagerly to his contemplated investigation on measles and whooping cough.

DR. J. R. HUTCHINSON : Dr. Stocks has done a service by calling attention to a phenomenon which was not discernible from an examination of the notification rates for the whole country. Epi-

to Dr. Stocks for his able analysis of the incidence of diphtheria and scarlet fever in 1939–40. The great social changes which then took place are far better described shortly by the title " dispersal " than by that of " evacuation," for much more was involved than the removal of 735,000 " unaccompanied " and 260,000 " accompanied " children from the evacuation to the reception areas.

It would be of great value to those who are concerned with the practical problem of the control of infectious diseases if it were possible to obtain some indication of the relative importance of the two factors involved in " dispersal "—that of " thinning out of the child population " and that of " school closure " (p. 318). It must be remembered that as soon as evacuation was completed the " drift back " began, and by the end of 1939 the number of unaccompanied evacuated children in the reception areas was reduced from about 735,000 to 420,000 and by mid-April to about 300,000. The " thinning-out " factor therefore operated with diminishing force throughout the months of greatest epidemic prevalence. The " school-closure " factor also operated with diminishing force, because by the beginning of January 1940 about 350,000 elementary school children in the evacuation areas were receiving full-time education, about 720,000 part-time education and about 420,000 no education at all. Of these figures those for " part-time education " and " no education " together probably give the best idea of the extent of school closure. The children receiving " part-time education " were being collected together every day to some extent, but in much smaller groups and for shorter periods than normally. Thereafter the schools in evacuation areas were opening gradually all the time. In the neutral areas it was estimated that about 95 per cent. of the children were back in school by the end of January 1940. The statement that " in the evacuation areas the schools were closed from the summer holiday in 1939 until the middle of 1940 or after " therefore needs some qualification. Exact figures about school opening are difficult to obtain, because many schools were opened gradually—*i.e.*, for older children at first and later for younger children also. There were considerable differences in different areas, both in the degree of evacuation and in the speed with which schools were reopened, and it would be of great interest if some record of the facts could be compiled for different areas before they are forgotten. Dr. Stocks's promised paper on measles and whooping cough will be awaited with something like impatience.

MR. W. T. RUSSELL : Dr. Stocks has rendered a great service to the Society and to all who are interested in public health by the presentation of this very interesting and valuable paper.

When evacuation was contemplated there was much concern as to the epidemiological consequences of mixing town and country children in the reception areas. It is certainly consoling to learn from Dr. Stocks that, so far, our worst fears have never been realised, since the notification rates both for scarlet fever and diphtheria have been less in the reception than in the neutral areas. His attempt to assess the respective contributions made by migrant and native

until Dr. Stocks's masterly analysis this partial fulfilment of our fears was masked for most of us by the lowness of the total notifications for England and Wales. But the wonder lies less in the sharpness of the rise than in its brevity.

School attendance seems to have been the main factor in differentiating the respective incidences in evacuation, neutral and reception areas. The main causes acting in the reception areas were probably overcrowding in school and billet, and the introduction of fresh strains of infection to which the native children were susceptible. Entry to a more susceptible herd might in turn react on the evacuated children entering it.

When Dr. Stocks says, " The children who arrived in the reception areas found themselves in a less crowded environment than before, but they attended school, whereas those left behind in the evacuation towns did not," it should, perhaps, be recalled that, although geographically speaking the environment of the evacuated children was "less crowded," yet the environment of the native children in home and school was much more crowded than before, and even the evacuated children in many cases may have been more crowded in their billets and schools than they were in the homes and schools they had left in the evacuation areas. Bedroom space in cottages and small houses in the country areas is normally on the small side, and the country schools, even where worked on the " double-shift " plan, were often overcrowded, while crude black-out devices sometimes interfered sadly with classroom ventilation. Moreover, in some reception areas classrooms were made into shelter rooms by bricking up windows, and, owing to pressure on accommodation, these had to continue to be used as classrooms, despite the impaired ventilation. When Dr. Stocks states that in the evacuation areas the schools were closed from the summer holiday in 1939 until the middle of 1940, I think he rather over-estimates the general period of closure. It would, I think, be more correct to say that most remained closed for a considerable part of the first six months of the war. About half were probably re-opened by February 1940 and most of the remainder by or before April 1940.

An interesting point mentioned by Dr. Stocks is that in the Southern reception areas the incidence of scarlet fever for the most part (save only an increase of 7 per cent. in " other urban areas ") declined, although, in contrast, all the Southern reception groups reported large increases in diphtheria notifications.

A possible explanation of this apparent difference in the relative incidence in these Southern reception areas of the two diseases, elsewhere so much alike, may perhaps be afforded by the recollection of the obvious but, as it was non-notifiable, unmeasured prevalence of tonsilitis in these areas after evacuation, and by the assumption that the prevalent local types of haemolytic streptococcus had lost their toxigenicity (or rash-producing power) while retaining their invasiveness.

Dr. A. H. GALE : All who are interested in the incidence of the epidemic diseases of childhood must acknowledge a debt of gratitude

areas may have been artificial. As Dr. Stocks points out, there is a large observational error in diphtheria notification. It is less, but not negligible, for scarlet fever. The evacuated children were in the care of anxious foster-parents, those of school age were more closely watched by their accompanying teachers than the native children had usually been, and the Ministry made provision, for the first time, for free domiciliary medical attendance for them. It will be noted that the effect, if any, of these circumstances would be an increase in the diagnosis and notification rates among *visitor* children. Examination of the death-rates, which are less open to this type of fallacy, might clear up these questions.

If these and other possible errors mentioned by Dr. Stocks are given their due weight, it seems unlikely that they would alter the broad conclusion from his analysis that the mixing of evacuated and native children in reception areas led to a temporary excess in the rate of infection in these areas, as compared with others not experiencing similar social changes. The difficult ascertainment of this occurrence was well worth while as affording confirmation of the modern theory of epidemics, based partly on field observations and partly on the work of Greenwood, Topley and their colleagues already mentioned. It will be noted that in certain of his tables Dr. Stocks assumes that the increased incidence noticeable in large groups of reception areas (over and above what happened in the neutral areas) occurred among the native children. It would be interesting if Dr. Stocks, in collaboration with some of the medical officers of health of reception areas which experienced a high prevalence, could find out if this was really the case. It would not be surprising if the rapid spread of an unaccustomed infection among native children led also to an increase among the visitors who brought it, by reason of more frequent and massive exposure, or, more speculatively, by an enhancement of its power to infect. Indeed, this question of the capacity of a strain of micro-organisms to change in infectivity and virulence in strange surroundings is a possibility as important to keep in mind as the well-established differences in the strains themselves, to which Dr. Stocks refers in discussing the third of the results which might follow the influx of a number of city children into a circumscribed area.

Dr. J. Alison Glover : Dr. Percy Stocks's admirable paper, whilst of great interest to all epidemiologists, must have a special appeal to anyone who, like myself, was rash enough to try to give an outline of the epidemiology of the first four months' evacuation, while still without the detailed information with regard to diphtheria and scarlet fever to which Dr. Stocks has had access, and which he has now marshalled with his unrivalled skill. The later paper on measles and whooping cough, which he promises us, will be eagerly awaited.

The sharp rise, after evacuation, of diphtheria and scarlet-fever notifications in the reception areas did, as Dr. Stocks points out, but in part fulfil the gloomy anticipations of many of us, though

long periods in epidemic seasons), so that it was not anticipated that epidemic prevalence would be materially influenced if closure were forced upon us by the outbreak of hostilities. On the other hand, the very careful and illuminating studies in experimental epidemiology of Greenwood, Topley and their colleagues * had led us to expect that the dispersal of town children, with their more or less symbiotic parasites, might set up dangerous new epidemic foci in the more susceptible child-populations of reception areas. It was thought likely, therefore, that evacuation would be followed by local flares-up in less populous areas of those infections, like diphtheria and scarlet fever, which may be regarded as endemic in the large towns providing the evacuees. The extent to which the general incidence throughout the country actually fell in the last quarter of 1939 has already been discussed by Glover,† who thought it might be due partly to the thinning out of children in evacuation areas and the closure of the schools in these areas; to the dispersal of children to private billets in reception areas and the double-shift system of schooling adopted there, which reduced the time of exposure of susceptibles to fresh strains of infection, and so allowed them to acquire some immunity by small and intermittent dosage; and the exceptionally good weather, which enabled both town and country children to be out in the open air to a maximum extent. It was assumed by Glover, it will be seen, that the anticipated rise of infectious disease in reception areas had not occurred. It had obviously not occurred on any great scale, but the differential incidence in evacuation, reception, and neutral areas merited the close examination which Dr. Percy Stocks has now given it.

The difficulties in estimating the child-population in the several areas must have been considerable even for one having access to all the official information available. This comment applies especially to the last quarter of 1939, after National Registration was completed, and before the food-rationing records can have afforded satisfactory evidence of the number of persons actually resident in any district. Much depends on the extent of unofficial evacuation after the end of September, about which one suspects very little is known.   There may therefore have been a fairly large error in calculations made on the basis of the estimated mid-year population of 1939, National Registration at September 29th, 1939, and the Ministry's records of evacuation movements.   If the estimated transference of population were too low, the calculated rates of incidence would obviously be inflated in reception areas and artificially low in evacuation areas. Another possible fallacy of a non-statistical character is in the extent to which there may have been differential standards of diagnosis and notification in the several types of district.   Probably Dr. Stocks is safe in assuming that only a small proportion of the fall in evacuation areas is likely to have been due to failure to ascertain and to notify cases as a result of school closure and other disturbances. It is perhaps more likely that a part of the increase in reception

* *Med. Res. Council, Sp. Rep. Series*, No. 209, 1936.
† *Proc. Roy. Soc. Med.*, 1940, **33**, 399.

the boundaries to a village, a street or an institution, and the odds shorten greatly. Admiral Dudley's classical study of the Royal Naval School is a modern instance. Even in the grimmer mid-Victorian days the dispersiveness of diphtheria or scarlet fever was nothing like that of pandemic influenza, although there is a tradition that in earlier days, even in the eighteenth century, the case was different. These are epidemiological reasons for explaining, *after* the event, why that happened which did happen.

Dr. Stocks makes the ingenious suggestion that we could account for the lack of correlation between attack rate and immigrant ratio if we postulate a number of strains of infective organisms. Suppose there are n reception areas $r_1, r_2 \ldots r_n$ and n evacuating areas $e_1, e_2 \ldots e_n$, then if, and only if, a particular combination $(r_s e_s)$ occurs, the e_s bringing to the r_s a strain to which e_s is sensitive, will local incidence be increased. Clearly this would water down the correlation considerably, for in a combination $(r_s e_t)$, however high the ratio of immigrants, no epidemiological effect would be produced, while in *any* $(r_s e_s)$ some effect might be postulated. But, if there were a sufficient number of $(r_s e_s)$ combinations for analysis, one would *still* expect that within the set morbidity would increase *pari passu* with the ratio of immigrants to home-keepers, because the dispersiveness of the diseases is not great. I suppose a detailed analysis is impracticable. If one takes the work done on the *gravis, mitis* and *intermediate* strains of *C. diphtheriae*, together with the fact that within each group there are variations of antigenic properties, as a basis for Dr. Stocks's hypothesis, it would seem likely that evacuees from a very large town, such as London, would be potentially more dangerous than evacuees from a relatively small town like Southampton. The General Register Office cannot, I think, trace evacuees from points of departure to points of reception; perhaps the Public Health Departments could.

That, however, is a research for leisure, and when leisure comes the data may no longer exist.

There is another feature of the massed data which puzzles me. Compare the experiences of receiving great towns and receiving rural areas in the table on p. 324. As one would expect, the pre-dispersal rates of the former are greater than those of the latter (by about 40 per cent.) but the a'/a ratios differ very little. One would suppose that the, presumably, more salted home-keepers of great towns would stand up better to the invasion than rural children; they did not. I am conscious that these desultory comments leave the problem unsolved and that paper and labour are scarce; but I could not forbear from paying a tribute to the] value of Dr. Stocks's research.

PROFESSOR R. M. F. PICKEN : The remarkable decline in the incidence of the common infections of childhood in the last quarter of 1939 was, I think, unexpected by most epidemiologists. Closure of schools had become discredited as a practical administrative procedure (although it had never been tried on a large scale and for

immunized mice were used, and these experiments are not directly relevant.

The results of many years' work are summarized in Special Report No. 209 of the Medical Research Council (Greenwood, Hill, Topley and Wilson). We found that the regular admission to a herd of small numbers of non-immunes always led to maintenance, and nearly always to greater or smaller explosive outbreaks of the disease under study, and that variation within quite wide limits of the quota of admissions from, say, one to six a day, did not greatly influence the average death-rate of the herd (*op. cit.*, pp. 30–31).

We also found (see Greenwood and Topley, *Journ. Hyg.*, xxiv, 1925, p. 66) that the introduction of large numbers of immigrants at irregular intervals did not produce such unfavourable effects on herd mortality as small regular additions. Since we did not carry that line of investigation further, it is not sound to draw a general conclusion, but observation of the habits of mice—in this respect not widely different from those of men—suggests that when new-comers arrive in a phalanx they may tend to keep themselves to themselves, so that the herd mixing is imperfect. One believes that the epidemiological equilibrium of the herd is upset by the continuous introduction of susceptibles; these, well mixed in herd, rapidly acquire the disease; within a few days all are infected; the herd is exposed to the fire of a new battery, and sooner or later something happens. What determines the moment of explosion we do not know. It seems unlikely that variations in the characters of the parasite are essential or even frequent factors of an intra-herd explosion. In one of our series that explanation could be definitely excluded. That is the story of immigrating susceptibles; if we change the signs of the expression, will symmetry permit us to deduce anything helpful?

As Dr. Stocks points out, given uniform mixing, the greater the proportion of potentially or actually dangerous immigrants the worse should be the look-out of the herd at home, But it is *possible* that as the ratio of immigrants to hosts increases, the less closely is the condition of uniform mixing fulfilled. When the immigration of new-comers is very large, it *might* be that the use of institutions for the housing of the immigrants becomes more important than a distribution over private families. It might be that special educational arrangements are made. When only two or three town children come into a village, presumably they attend the same classes as the village children; for a large number there might be separate classes. These are mere guesses, but it does seem possible that uniformity of mixing would not proceed *pari passu* with increase of the percentage of immigrants.

The intimate mixing, the really well-shuffled pack of cards, is, I think, of the essence of the problem. If our " universe " is large— the whole country or even a great city—scarlet fever and diphtheria are uncommon diseases in the arithmetical sense. I think for the whole country the odds would be of the order of magnitude of, say, 50 to 1 against a child under 15 contracting either disease in a calendar year—say about 100 to 1 against each event. But narrow

DISCUSSION ON DR. STOCKS'S PAPER

PROFESSOR GREENWOOD : Our Society can justly claim to have given to the world a majority of the most important medical-statistical papers, other than official documents, which have been printed in England during the past century. This paper is the best contribution to statistical epidemiology printed since the outbreak of war, and likely to remain so until Dr. Stocks fulfils his welcome promise to address us again. For many reasons, some good, others less good, statistical epidemiology is at present a branch of research confined to persons holding official posts. That is one of the evils of war. We have this consolation, that *one* official has not allowed the heavy pressure of day-to-day duties to blunt his keenness to elucidate general scientific problems.

The nightmare conditions of life since September 1939, the peripeteia of war, in the first winter a theatrical unreality, then a sense of imminent, overwhelming danger, followed by the miseries of the second autumn–winter, disturbed the judgments of the wisest, even of epidemiologists, and some forgot the sound rule of only prophesying after the event. Rather more than a year ago a medical speaker in the west of England was reported (perhaps incorrectly) to have said that unless all the laws of medicine were wrong, a great epidemic was imminent. Many years of addiction to arithmetic have imposed upon my natural impetuosity a certain caution, but I did feel, and express, anxiety respecting the prospects of influenza in the winter–spring of 1940–1. My reasoning was based partly on assumptions which were plausible enough but actually incorrect. I much over-estimated the proportion of exposed to risk in danger areas really subjected to those Black Hole conditions which much experimental evidence had proved to be capable of generating fearful epidemics of droplet infections. The relevance of this autobiographical anecdote is that, quite apart from the intrinsic difficulty of epidemiological forecasting, many extrinsic factors are not easily studied, or even known in these times of stress. Dr. Stocks has given us much information, but much remains which only the leisure of historians can provide.

This is the essence of the problem. Those who expected that a scattering of town children throughout the country would lead to an increase of morbidity from diphtheria and scarlet fever among the children of reception areas, were justified by the event. But those who expected that the greater the ratio of immigrant children to the population of resident children the worse would be the situation of the latter, were not justified by the result. Why not?

I make no apology for turning instantly to my King Charles's Head, the results of experimental epidemiology.

In this study one has a mirror image of the human experiment. We did not (except, of course, at the beginnings of an experiment) introduce infective migrants to a community of non-immunes, but the converse. Into a herd in which the disease existed non-immunes were introduced. The only variation of this rule was when

Quarterly Notification Rates per 10,000 *children under* 15—(continued)

		DIPHTHERIA						SCARLET FEVER					
		1939				1940		1939				1940	
		1	2	3	4	1	2	1	2	3	4	1	2
OTHER URBAN AREAS	Ecl	27	42	5	—	—	5	164	201	171	48	20	23
	Ecsmn	100	53	74	39	43	43	82	92	45	26	21	35
	EVACUATION	79	50	49	29	32	32	105	122	80	34	21	31
	Ncl	29	25	16	20	13	22	92	88	60	45	34	32
	Ncsmn	91	57	62	73	42	41	98	85	84	62	59	57
	NEUTRAL	82	53	36	64	37	37	98	87	81	59	55	53
	Rc 0–	65	28	43	53	31	37	85	67	72	91	61	42
	10–	28	26	38	30	17	12	57	64	56	101	59	58
	20–	52	40	37	54	25	25	74	97	102	132	64	59
	30–	43	34	43	69	41	35	51	65	83	103	45	38
	40–	45	20	49	57	31	24	95	67	70	89	69	60
	50–	34	31	56	67	33	30	73	68	79	86	52	40
	100–	70	27	48	75	43	17	48	67	78	71	42	38
	Rcs	22	14	30	36	15	18	69	63	59	67	38	23
	Rcm	65	37	56	78	39	34	69	71	88	122	71	54
	Rcn	56	43	51	69	41	35	82	84	89	113	69	76
	RECEPTION	47	30	45	59	31	28	73	71	78	98	57	48
RURAL DISTRICTS	NEUTRAL	36	28	33	39	32	21	60	46	33	53	47	35
	Rd 0–	53	33	36	51	31	32	62	38	59	76	51	43
	10–	52	30	37	47	36	28	75	77	77	90	59	50
	20–	24	17	23	38	24	22	61	53	59	65	66	45
	30–	21	13	21	30	19	15	65	62	50	72	63	38
	40–	38	36	32	45	23	22	69	58	65	73	53	35
	50–	31	24	29	38	19	19	66	55	74	85	54	38
	100–	2	5	13	52	41	32	83	43	66	48	50	41
	Rds	22	14	22	25	19	15	52	46	41	38	33	19
	Rdm	36	26	29	47	27	29	68	55	69	94	62	41
	Rdn	68	43	44	58	36	28	86	82	92	112	92	83
	RECEPTION	38	26	30	41	26	24	66	58	65	77	38	42

Quarterly Notification Rates per 10,000 children under 15

		DIPHTHERIA						SCARLET FEVER					
		1939				1940		1939				1940	
		1	2	3	4	1	2	1	2	3	4	1	2
ENGLAND AND WALES		60·6	41·3	43·1	19·3	36·4	36·4	89·6	87·2	75·7	69·0	52·1	47·6
GREAT TOWNS	Ea L	68	51	58	36	33	30	89	97	70	41	43	37
	Eal	48	37	34	21	26	21	105	107	51	36	37	37
	Eas	12	28	23	15	17	12	79	99	56	31	29	15
	Eam	56	45	49	35	41	54	84	91	89	55	52	50
	Ean	90	67	62	60	50	54	109	105	74	52	41	47
	EVACUATION	70	51	48	44	39	41	98	101	76	48	42	41
	Nal	36	19	18	14	18	16	107	116	64	32	33	39
	Nas	48	51	58	65	60	92	75	95	86	66	45	49
	Nam	69	45	51	65	59	54	120	103	106	71	62	57
	Nau	99	58	56	73	48	56	129	112	92	86	63	58
	NEUTRAL	71	46	49	57	49	52	118	108	93	69	57	54
	Ra 0–	65	46	50	75	84	69	132	125	121	178	166	90
	10–	83	62	62	85	31	50	103	102	83	116	69	89
	20–	19	21	19	32	23	21	97	76	58	62	58	64
	30–	21	17	21	25	16	15	70	79	66	60	31	50
	40–	93	40	53	111	67	59	138	96	61	63	55	50
	50 up	57	30	47	47	15	18	84	86	91	58	42	55
	Ras	29	23	31	51	30	27	75	75	58	38	26	32
	Ram	52	30	37	37	28	23	90	73	84	104	96	39
	Ran	99	66	65	72	43	39	171	170	136	148	135	150
	RECEPTION	50	33	39	58	32	32	98	92	81	90	69	65
SMALL TOWNS	Ebl	24	17	13	12	7	15	170	177	70	39	34	52
	Ebsmn	57	39	51	43	27	39	93	88	67	43	34	37
	EVACUATION	47	33	42	35	21	32	113	115	68	36	34	41
	Nbl	30	13	17	15	21	18	93	104	75	49	40	45
	Nbsmn	85	33	51	45	42	43	88	81	80	49	47	45
	NEUTRAL	70	42	41	38	36	36	89	87	79	49	45	45
	Rb 0–	90	49	59	123	105	101	101	76	74	88	66	82
	10–	51	27	60	95	29	42	74	83	81	65	39	58
	20–	44	19	29	33	35	34	50	51	55	87	53	41
	30–	32	17	28	30	32	31	71	41	46	86	65	35
	40–	46	24	45	33	15	21	40	76	71	54	41	45
	50–	56	48	51	40	23	16	70	60	35	64	41	61
	100–	108	59	5	108	111	—	91	113	312	61	77	36
	Rbs	20	15	29	35	14	16	40	40	42	33	26	20
	Rbm	96	48	63	128	99	98	110	81	84	99	65	74
	Rbn	75	33	56	37	45	29	71	96	92	106	52	121
	RECEPTION	66	38	50	76	37	55	79	70	71	75	54	62

Quarterly Diphtheria and Scarlet-Fever Notifications

(d) Rural districts

Group of areas	Population under 15		Number of notifications (Civilians, all ages)													
			DIPHTHERIA								SCARLET FEVER					
			1939				1940				1939				1940	
	p_0	x	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Nds — Rest of South	15,110	+3	1	3	1	62	1	1	1	5	19	17	11	31	11	7
Ndm — Midlands, Wales	11,110	+7	40	21	36	11	55	28	23	103	77	51	33	42	57	18
Ndn — North	7,290	+12	14	22	21		3	10	27	22	10	15	11	24	20	10
Nd — Total NEUTRAL	63,810	+6	64	49	59	74	59	39	51	130	106	82	58	100	88	65
Rd 0—	302,280	+9	487	297	325	500	301	314	107	670	548	347	536	751	502	417
10—	308,590	+21	411	256	317	485	351	276	306	152	610	659	659	914	580	489
20—	214,270	+35	113	100	138	290	178	162	102	249	363	331	350	570	181	327
30—	236,730	+37	111	97	136	263	160	120	112	195	427	106	327	631	325	301
40—	157,980	+38	161	159	139	239	127	120	139	178	302	251	287	433	298	189
50—	128,380		97	71	118	220	86	96	80	156	222	214	288	501	211	161
60—	61,370	+54	53	50	39	82	19	36	46	72	91	93	110	159	103	83
70—	19,290		13	18	15	56	21	17	15	6	31	29	30	89	57	50
80—	15,170		42	12	21	36	8	19	17	28	75	8	25	58	44	18
90—	15,280		2	5	3	4	6	6	17	10	20	10	36	39	55	20
100—	14,130	+61	1	3	6	32	23	17	3	11	13	17	26	30	28	22
Rds — Rest of South	509,510	+12	309	198	315	498	355	272	318	190	731	615	577	730	696	318
Rdm — Midlands, Wales	660,860	+23	672	485	546	1,052	383	621	696	1,038	1,256	1,022	1,278	2,116	1,347	876
Rdn — North	320,090	+26	603	384	395	637	578	285	320	199	765	731	819	1,231	961	859
Rd — Total RECEPTION	1,499,460	+30	1,584	1,067	1,256	2,187	1,316	1,177	1,364	2,027	2,755	2,398	2,674	3,097	2917	2,083

(All regions grouped according to billeted per cent. of native children 5–15 at end of September 1939)

Quarterly Diphtheria and Scarlet-Fever Notifications

(c) Other urban areas (under 25,000 population)

Number of notifications (Civilians, all ages)

Code	Group of areas	P_0	±	Diph. 1939 1	2	3	4	Diph. 1940 1	2	3	4	Scarlet 1939 1	2	3	4	Scarlet 1940 1	2
Ed	London outer ring	14,710	−20	11	17	2	—	—	3	3	4	67	82	70	16	7	8
Ecs	Rest of South	5,030	−1	1	1	—	—	—	—	—	—	6	5	13	7	3	1
Ecn	North	32,230	−9	104	55	78	33	43	44	30	58	81	92	35	21	18	34
Be	Total EVACUATION	52,870	−12	117	73	80	38	43	47	33	63	154	179	118	44	28	43
Ned	London outer ring	90,640	+0	72	61	41	53	37	62	52	186	232	222	150	122	95	88
Nes	Rest of South	55,380	+0	63	20	21	22	8	24	18	58	83	84	78	59	46	76
Ncm	Midlands, Wales	95,550	+8	237	161	130	255	125	91	125	136	222	256	251	239	215	163
Ncn	North	314,800	+3	890	556	654	690	430	420	558	790	568	765	757	531	534	531
Ne	Total NEUTRAL	516,410	+7	1,242	801	849	1,020	600	606	733	1,130	1,105	1,327	1,236	951	890	858
Re 0—	*All regions grouped according to billeted per cent. of native children 5–15 at end of September 1939*	174,780	+10	310	135	200	285	166	107	317	353	412	325	350	490	327	225
10—		90,790	+20	70	65	95	88	50	35	43	236	143	161	140	298	169	166
20—		133,740	+30	192	148	136	262	115	117	115	220	276	362	370	613	298	270
30—		100,700	+32	121	96	121	244	139	117	116	152	142	181	231	368	152	128
40—		90,867	+48	126	59	137	211	108	81	184	171	203	186	103	330	240	205
50—		63,310	} +55	51	44	64	157	80	87	121	135	93	81	104	220	123	73
60—		60,810		64	74	107	205	68	77	77	80	127	153	140	264	167	113
70—		33,300		17	11	57	45	25	19	13	29	55	33	60	92	61	57
80—		18,100		46	32	66	117	56	18	19	25	81	63	68	82	9	23
90—		16,260		1	4	3	8	9	0	9	13	35	32	50	15	28	16
100—		45,020	+74	89	34	61	161	78	29	64	109	61	86	99	143	77	66
Rcs	Rest of South	208,026	+58	181	115	249	420	203	200	346	351	571	522	491	789	421	251
Rcm	Midlands, Wales	310,763	+33	576	325	494	828	405	339	406	560	617	630	785	1,300	730	519
Rcn	North	218,575	+40	330	250	312	525	295	247	312	618	500	500	538	862	500	539
Rc	Total RECEPTION	837,264	+44	1,000	699	1,056	1,173	903	780	1,124	1,532	1,688	1,661	1,814	2,951	1,651	1,312

Quarterly Diphtheria and Scarlet-Fever Notifications

(b) *Small Towns* (25,000–50,000 *population*)

	Group of areas	P_0	x	Diphtheria 1939 — 1	2	3	4	Diphtheria 1940 — 1	2	3	4	Scarlet Fever 1939 — 1	2	3	4	Scarlet Fever 1940 — 1	2
Elb	London outer ring	56,040	−18	37	27	21	16	10	20	25	18	264	276	109	50	40	71
Esb	Rest of South	63,530	−17	75	46	26	15	13	21	34	27	170	172	105	41	42	53
Emb	Midlands, Wales	17,410	+3	15	4	23	36	16	20	28	35	39	47	36	31	28	21
Enb	North	49,320	−11	119	91	151	90	62	93	98	246	122	106	105	68	29	53
Eb	Total EVACUATION	185,200	−14	246	170	221	157	101	154	185	326	604	601	355	190	168	198
Nlb	London outer ring	147,830	−1	125	53	70	61	85	72	61	173	381	428	307	196	102	185
Nsb	Rest of South	51,400	0	29	37	34	23	31	23	42	88	46	90	70	51	64	41
Nmb	Midlands, Wales	156,070	+5	265	185	150	197	149	183	191	365	340	377	406	212	191	216
Nnb	North	205,000	+2	678	388	396	315	309	295	301	351	621	466	438	312	293	275
Nb	Total NEUTRAL	560,990	+2	1,097	662	649	596	574	573	595	977	1,388	1,361	1,227	774	713	717
Rb 0–	All regions grouped according to billeted per cent. of native children 5–15 at end of September 1939	174,230	+19	437	238	285	651	552	530	490	571	504	369	357	405	348	432
10–		51,800	+27	73	39	87	160	49	60	96	114	107	119	117	110	65	95
20–		55,290	+35	67	20	45	63	65	62	103	112	77	79	84	167	98	75
30–		22,850	+40	20	11	18	25	26	25	20	10	45	26	29	64	53	28
40–		46,110		69	30	57	57	25	34	70	112	51	97	91	65	69	74
50–		31,010		31	24	38	72	46	83	36	27	58	63	58	83	53	77
60–		11,240	+68	58	2	42	15	10	5	4	10	32	17	11	18	10	7
70–		8,070		8	2	7	7			2		10	7	7	19	15	9
90–		14,080		3	2	5	15	3	2	10	11	26	23	23	55	23	56
100–		6,690	+66	20	11	1	32	29		8	10	17	21	58	18	20	9
Rsb	Rest of South	141,840	+41	77	58	113	187	73	84	154	133	157	166	165	176	189	100
Rmb	Midlands, Wales	202,410	+13	539	272	353	807	611	603	598	689	617	457	472	621	400	454
Rnb	North	77,120	+35	160	114	119	103	121	73	96	155	152	206	198	207	219	305
Rb	Total RECEPTION	421,370	+26	776	444	585	1,097	805	760	848	977	926	819	835	1,094	768	862

Quarterly Diphtheria and Scarlet-Fever Notifications

(a) Great Towns

		Population under 15		Number of notifications (Civilians, all ages)																		
				DIPHTHERIA								SCARLET FEVER										
				1939				1940				1939				1940						
Group of areas		p_0	x	1	2	3	4	1	2	3	4	1	2	3	4	1	2					
Ela	London A.C.	751,090	−51	1,111	1,130	793	375	400	383	128	613	1,857	2,081	1,157	425	515	466					
Ela	London outer ring	157,790	−37	617	172	137	173	238	204	215	184	1,335	1,350	1,031	206	313	356					
Eva	Rest of South	131,100	−33	153	103	83	39	15	32	36	33	257	360	205	81	76	62					
Ema	Midlands, Wales	432,830	−7	675	511	393	107	172	620	557	972	1,009	1,001	1,008	612	592	578					
Ena	North	1,117,210	−21	2,503	2,066	1,910	1,510	1,318	1,171	1,716	2,093	3,374	3,211	2,308	1,330	1,118	1,370					
Ea	Total EVACUATION	2,890,050	−31	5,662	4,312	3,814	2,534	2,478	2,710	2,095	4,028	7,862	8,098	6,072	2,783	2,671	2,711					
Nla	London outer ring	136,070	−8	130	82	77	56	71	63	60	137	165	507	277	129	135	158					
Nsa	Rest of South	61,210	—	100	111	131	117	155	208	132	632	170	214	103	160	102	110					
Nma	Midlands, Wales	143,630	+3	818	556	651	745	710	675	1,100	1,377	1,177	1,275	1,301	878	783	730					
Nna	North	392,010	+2	1,082	624	609	768	521	616	711	1,024	1,103	1,218	1,006	905	687	610					
Na	Total NEUTRAL	1,073,850	0	2,194	1,380	1,151	1,716	1,470	1,660	2,326	3,190	3,515	3,211	2,777	2,061	1,707	1,628					
Ra 0—	All regions grouped according to billeted per cent. of native children 5–15 at end of September 1939	61,950	+5	118	83	90	111	158	129	221	215	239	226	218	331	311	168					
10—		50,120	+21	116	87	87	125	63	52	217	325	143	112	115	170	115	119					
20—		73,920	+28	39	12	39	41	58	52	93	64	109	156	119	150	116	158					
30—		82,380	+30	18	10	19	72	45	40	61	91	161	181	130	176	111	136					
40—		29,280	+39	76	33	15	123	70	61	31	101	112	76	50	69	61	51					
50—		26,010		8	6	11	31	12	2	10	31	20	36	32	11	19	77					
70—		15,090	+65	4	—	10	62	12	18	6		20	26	32	67	27	72					
80—		25,650		58	32	12	82	27	21	66	124	67	30	79	77	31	11					
100—		17,030	+83	71	33	10	28	6	20	21	15	100	86	90	50	37	32					
Rsa	Rest of South	190,780	+38	153	122	163	366	208	176	210	150	308	395	308	272	179	210					
Rma	Midlands, Wales	124,980	+20	182	101	129	160	111	163	130	561	311	253	290	129	370	237					
Rna	North	73,470	+51	203	131	132	218	121	107	91	282	310	316	277	115	376	110					
Ra	Total RECEPTION	389,230	+32	538	360	421	731	110	128	761	1,002	1,061	991	975	1,116	934	557					

p_0 = estimated population before dispersal. x = per cent. change for 4th quarter, 1839.

explanation of the increase observed in the reception areas cannot be found on these lines, and we are left with a third possibility, viz. :

(3) The native children of a community are in a state of temporary immunological equilibrium with the local types of the infective organisms which may be disturbed by : (*a*) changes in immunity, (*b*) changes in virulence of the local types of organism, or (*c*) importation of a new variety from outside the community, and when one of these happens, an epidemic is liable to start and to proceed until a new equilibrium is reached. There is no reason why changes under (*a*) and (*b*) should have affected the reception areas more than other areas, and the explanation must apparently be sought in (*c*). At the initial evacuation of children most reception areas received all their children from a single city, and a single type of organism would tend to be prevalent amongst the children arriving in any one area. If the native community was already in equilibrium with that type, no epidemic would be likely to result, but, if not, an epidemic might follow, and the number of native children affected by it would not depend on the number of carriers who started it. In other words, the danger of an epidemic starting would not be appreciably greater in areas receiving 500 immigrants than in those receiving only 50. In a few instances an epidemic might occur amongst the billeted children, but this would be less likely, on account of their higher level of immunity.

This explanation (if in fact it " explains " anything) would conform with the observed facts, but it is not necessarily the correct one, for no doubt there are other possible explanations which have not occurred to the author.

This summary must suffice, but it is hoped that the tabulated data will provide the necessary material for future discussion of the epidemiological implications. It is hoped also to present some data regarding measles and whooping cough in a later paper.

dispersal (fourth quarter). For diphtheria these limits were 52 and 43 respectively and for scarlet fever they were 102 and 48.

Except in the groups of great towns, the pre-dispersal rates, a, did not differ to any important degree in the towns which received visitor children to the extent of 40 per cent. or more of the native children compared with the towns where the influx was under 20 per cent. The ratios of the post-dispersal to pre-dispersal rate amongst the native children, a'/a, do not show any consistent tendency to rise as the proportion of visitor children increases, except perhaps in the urban areas of less than 25,000 population for diphtheria; in the small towns the diphtheria ratios decline as the proportion increases.

The small towns which received children numbered 59, and the average number billeted in October 1939 was 1,184 per town; for the six small towns which showed the largest increases in diphtheria incidence in the fourth quarter the average number billeted was 1,108. The urban areas with less than 25,000 population which received children numbered 495 and the average number billeted was 409; for the thirteen areas with largest increases in diphtheria the average number billeted was 491. This demonstrates in another way that the increase in diphtheria incidence immediately after the reception of city children did not depend on the size of the quota received.

This lack of association may be significant from the point of view of epidemiological theory, for it means that the average rise in incidence of diphtheria and scarlet fever amongst the native children after the arrival of the city children did not depend on the numbers of the latter, and was in general no greater where 500 came in than where 50 came in. If we had no knowledge of the epidemiology of these diseases, it might be inferred from general principles that one of three results must follow the influx of a number of city children into a small circumscribed area.

(1) If a small proportion of the billeted children are carriers of the infecting organisms, and each carrier tends to infect a certain number of non-immune contacts, it would be anticipated that about ten times as many native children would contract the disease in areas receiving 500 children as in areas receiving only 50.

(2) If a small proportion of the billeted children are carriers of infection, and if an epidemic, once started amongst the native children, tends to run through the population until the bulk of the non-immunes have been affected, the chance of such an epidemic occurring would be much greater in areas receiving 500 children than in areas receiving only 50.

Since the facts do not support either of these alternatives, the

b' = post-dispersal rate amongst the billeted children (fourth quarter).

A = post-dispersal population of native children (fourth quarter).

B = post-dispersal population of billeted children (fourth quarter),

then
$$1 + \frac{z}{100} = \frac{1}{a} \cdot \frac{Aa' + Bb'}{A + B} = \frac{a'}{a} \cdot \frac{A}{A+B} + \frac{b'}{a} \cdot \frac{B}{A+B}$$

leading to :

$$\frac{a'}{a} = \left(1 + \frac{z}{100}\right)\left(1 + \frac{B}{A}\right) - \frac{b'}{a} \cdot \frac{B}{A}.$$

Since A did not change appreciably in the interval, the values of B/A are obtained by dividing the percentage increases of population in the first columns of the table above by 100. The pre-dispersal rates, a, obtained by dividing the second-quarter notifications by $p_0/4$, are taken from the large table. The values of b' may be assumed to lie between the rate experienced by the migrant children as a whole when in their own towns in the second quarter and the rate experienced by those left behind in the evacuation areas after

Reception-area group	Estimated change in incidence rate amongst native children							
	Diphtheria				Scarlet fever			
	Pre-dispersal rate, a	$\frac{Aa' + Bb'}{a(A+B)}$	$\frac{a'}{a}$ when :		Pre-dispersal rate, a	$\frac{Aa' + Bb'}{a(A+B)}$	$\frac{a'}{a}$ when :	
			$b'=52$	$b'=43$			$b'=102$	$b'=48$
Great towns :								
R 0–	46	1·63	1·7	1·7	125	1·50	1·5	1·6
10–	62	1·37	1·5	1·5	102	1·14	1·2	1·3
20–	21	1·52	1·3	1·4	76	0·82	0·7	0·9
30–	17	1·47	1·0	1·2	79	0·76	0·6	0·8
40–	40	2·77	3·3	3·4	96	0·66	0·5	0·7
50 and over	30	1·37	1·5	1·7	86	0·67	0·1	0·7
Small towns :								
R 0–	49	2·51	2·7	2·7	76	1·16	1·1	1·2
10–	27	3·52	3·8	3·9	83	0·78	0·8	0·8
20–	19	1·74	1·5	1·6	51	1·71	1·6	1·9
30–	17	1·76	1·3	1·5	41	2·10	2·0	1·4
40–	24	1·37	1·1	1·2	76	0·71	0·5	0·7
50 and over	55	0·96	1·0	1·1	73	0·98	0·7	1·2
Other urban :								
R 0–	28	1·89	1·9	1·9	67	1·36	1·3	1·4
10–	26	1·15	1·0	1·1	64	1·58	1·6	1·8
20–	40	1·35	1·4	1·5	97	1·36	1·5	1·7
30–	34	2·03	2·2	2·3	65	1·58	1·6	1·9
40–	20	2·85	2·9	3·1	67	1·33	1·3	1·6
50 and over	34	2·30	2·7	2·9	75	1·22	1·1	1·6
Rural areas :								
R 0–	33	1·55	1·6	1·6	38	2·00	1·9	2·1
10–	30	1·57	1·5	1·6	77	1·17	1·1	1·3
20–	17	2·24	2·0	2·1	53	1·16	0·9	1·3
30–	13	2·31	1·7	1·9	62	1·16	1·0	1·3
40–	36	1·25	1·2	1·3	58	1·26	1·1	1·4
50 and over	25	1·77	1·6	1·8	63	1·44	1·3	1·8

Amongst the reception areas before the dispersal the small towns with populations of 25,000 to 50,000 had the highest diphtheria rate, and this rate was immediately doubled; the urban areas, with smaller populations, registered 97 per cent. increase, the great towns 73 per cent. and the rural districts 58 per cent., compared with 17 per cent. in the neutral areas. The northern great towns used for reception failed to show any important increase, and the northern small towns, a small group, registered a decline, but the other northern areas showed substantial increases. The southern reception groups all registered large increases, the urban rates being more than doubled, and this was true also of the smaller towns in the Midland belt. For scarlet fever, the great and small reception towns, whilst failing to show a decline comparable with that in the neutral areas, did not register important increases except in the Midland belt, but the rural districts and small urban areas showed large increases in the Midlands and moderate increases in the north. In the southern reception areas for the most part incidence declined.

When the reception areas are grouped according to the *proportion of officially billeted to native children* of school age at the end of the third quarter of 1939, the following comparison is obtained :

Group	Great towns			Small towns			Other urban			Rural districts		
	Popn.	Diph.	S.F.	Popn.	Diph.	S.F.	Popn.	Diph.	S.F.	Popn.	Diph.	S.F.
R 0–	5	63	50	10	151	16	10	89	36	9	55	100
10–	24	37	14	19	252	–22	20	15	58	21	57	17
20–	25	52	–18	27	74	71	36	35	36	35	124	16
30–	30	47	–24	35	76	110	32	103	58	37	131	16
40–	39	177	–34	40	37	–29	38	185	33	38	25	26
50 and over	61	57	–33	68	–4	– 2	59	130	22	55	77	44
Total	32	73	– 2	26	100	7	34	97	35	30	58	33

Percentage increase (or decrease) in population under 15 and in the rates of incidence in 4th quarter compared with 2nd quarter of 1939

In the great towns the diphtheria increase was maximal in the group where the visitor children numbered 39 per cent. of the native children; in the small towns it was maximal where this proportion was 19 per cent., in other urban areas where it was 59 per cent., and in rural districts where it was 37 per cent. Following a suggestion by Professor Greenwood, a further analysis of the above data has been made. If z = percentage increase in the incidence rate in the fourth quarter compared with the second quarter of 1939 in a group of reception areas as given in the table above,

a = pre-dispersal rate in the group (second quarter).

a' = post-dispersal rate amongst the native children (fourth quarter).

uniform amongst the groups of great towns, and the immediate fall in incidence was greatest in the north (79 per cent.) and least in the Midland belt (40 per cent.)

	Population under 15	Diphtheria		Scarlet fever	
	Per cent change	Rate per 10,000 in 2nd quarter 1939	Per cent. change in 4th quarter	Rate per 10,000 in 2nd quarter, 1939	Per cent. change in 4th quarter
Neutral areas	+3	46	+17	96	−36
Evacuation areas:					
(a) *Great towns:*					
London A.C.	−54	54	− 33	97	−58
London's outer ring ...	−37	37	− 43	107	−66
Rest of South ...	−33	28	− 46	99	−69
Midlands and Wales...	− 7	45	− 22	91	−40
North	−21	67	− 10	105	−79
Total	−31	54	− 19	101	−51
(b) *Small towns:*					
London's outer ring ...	−18	17	− 29	177	−78
Rest of England and Wales	−13	39	+ 10	88	−52
Total	−14	33	+ 6	115	−69
(c) *Other urban areas* ...	−12	50	− 42	122	−72
Reception areas:					
(a) *Great towns:*					
South	+38	23	+122	75	−49
Midlands and Wales...	+20	30	+ 23	73	+42
North	+51	66	+ 9	170	−13
Total	+32	33	+ 73	92	− 2
(b) *Small towns:*					
South	+41	15	+133	40	−17
Midlands and Wales...	+13	48	+167	81	+22
North	+35	53	− 30	96	+10
Total	+26	38	+100	70	+ 7
(c) *Other urban areas:*					
South	+48	14	+157	63	+ 7
Midlands and Wales...	+24	37	+111	71	+72
North	+30	43	+ 60	84	+35
Total	+34	30	+ 97	71	+38
(d) *Rural districts:*					
South	+42	14	+ 79	46	−17
Midlands and Wales...	+23	26	+ 81	55	+71
North	+26	43	+ 35	82	+37
Total	+30	26	+ 58	58	+33

percentage ratio of the reception-area rate to that in the evacuation areas showed the following progression in the six quarters : 76, 67, 96, 175, 164, 139.

Scarlet-fever incidence amongst children under 15, as indicated by notification rates, fell more rapidly in the evacuation towns than in the neutral areas, and showed no sign of recovery up to the middle of 1940. The reception-area rate, however, instead of declining, increased after the dispersal from about 30 per cent. below the neutral-area level to 38 per cent. above, falling back to about the neutral-area level by the second quarter of 1940. If the children removed to the reception areas experienced the same decline in scarlet-fever incidence as the neutral-area children, we should have in those areas :—

	2nd quarter 1939		4th quarter 1939	
	Per cent. of total children	Rate per 10,000	Per cent. of total children	Rate per 10,000
Visitor children ...	—	(102 at home)	24	65
Native children ...	100	68	76	y
Total children in reception areas ...	100	68	100	84

whence $y = 90$, which means that scarlet-fever incidence amongst the native children increased by 32 per cent., whilst the neutral-area rate was falling by 36 per cent. and the evacuation-area rate falling by 53 per cent. This leads to the broad inference that the immediate effect on the native children of the reception areas of the influx of visitor children was of the same kind and degree for scarlet fever as for diphtheria, but it was more lasting.

Dividing the areas according to their *geographical situation* and degree of *urbanization*, the percentage changes in the rates of incidence of the two diseases in the fourth quarter of 1939 compared with those in the same groups of areas in the second quarter before dispersal took place were as shown on p. 322.

Amongst the evacuation towns, those in the north showed the highest diphtheria incidence before the dispersal, and only a moderate fall of 10 per cent. in the fourth quarter of 1939 and 25 per cent. by the first quarter of 1940. In the Midland belt the decrease in the fourth quarter amounted to 22 per cent., in London to 33, in the outer ring to over 40 and in other southern towns to 46 per cent. The small towns outside Greater London registered no decline until the first quarter of 1940, when it amounted to 31 per cent. For scarlet fever the pre-dispersal rate was fairly

which can be done conveniently for both diseases together, the general results with regard to scarlet fever will first be compared with those arrived at above for diphtheria.

Comparing the aggregates of all areas as before, the *Scarlet-fever* notification rates per 10,000 children under 15 were :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	104	96	85	61	53	51
Evacuation areas	99	102	75	48	36	36
Reception areas	75	68	72	84	59	50
England and Wales ...	*90*	*87*	*76*	*69*	*52*	*78*

Expressed as percentages of the rates in the neutral areas, these become :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	100	100	100	100	100	100
Evacuation areas	95	106	88	79	68	71
Reception areas	72	71	85	138	111	98

and expressed as percentages of the rates in the June quarter of 1939 :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	108	100	89	64	55	53
Evacuation areas	97	100	74	47	35	35
Reception areas	110	100	106	124	87	74
England and Wales ...	*103*	*100*	*87*	*79*	*60*	*90*

Normally scarlet-fever incidence is maximal in the first quarter, as in 1936, 1938 and 1939, but sometimes in the fourth quarter, as in 1937. In the quarters before dispersal the neutral and evacuation areas experienced similar rates, whilst those in the reception areas were lower. During the six quarters under review the neutral areas showed a continually declining incidence, the fall in the fourth quarter of 1939 compared with the second being 36 per cent., and in the first quarter of 1940 45 per cent. In the evacuation areas the corresponding fall amounted to 53 per cent. in the fourth quarter and 65 per cent. by the first quarter of 1940, but the reception areas registered a rise of 24 per cent. followed by a decline in 1940. The

visitor children in the fourth quarter of 1939. if we suppose that they did not benefit from their changed environment. would be 17 per cent. as experienced by the neutral area children. which would have raised their rate from 52 to 61 per 10,000.   Thus we should have in the reception areas :

	2nd quarter 1939		4th quarter 1939	
	Per cent. of total children	Rate per 10,000	Per cent. of total children	Rate per 10,000
Visitor children ...	—	(52 at home)	24	61 (or less)
Native children ...	100	30	76	y
Total children in reception areas ...	100	30	100	51

whence $y = 48$ or more, which means that diphtheria incidence amongst the native children of the reception areas increased by at least 60 per cent.   This assumes that the effect of school attendance on the children of the evacuation areas was all-important. and that their change of environment had no favourable effect on their liability to diphtheria, but it is more probable that their pre-dispersal rate of 52 was not increased, in which case $y = 51$ and the increase amongst the native children must have been 70 per cent.

Two broad inferences can be drawn, viz. :

(1) Removal of some 30 per cent. of the children under 15 from the evacuation towns, coupled with closure of the schools, was followed by a fall of 40 per cent. or more in the rate of diphtheria amongst the children who remained, compared with 9 per cent. in the neutral areas, by the first quarter of 1940.

(2) Influx of children drawn from these towns to the reception areas, with consequent increase in their population at ages under 15 by about 30 per cent., was followed by an immediate rise of diphtheria incidence amongst the native children amounting to 60 or 70 per cent. as measured by notifications, but the rate in the whole population of children in these areas declined again within six months to its original level.

The temptation to discuss the epidemiological implications of these happenings has been resisted in this paper except for a brief comment at the end, but they provide material for considerable conjecture.   I have found no evidence to support the view that they can be explained away by the vagaries of notification or increased vigilance of Health Departments in the reception areas.

Before considering the happenings in groups of areas classed according to geographical position and degree of urbanization,

N 2

the quarter following the dispersal, but by the second quarter of 1940 the rate had returned to the same level as a year previously. The estimated notification rate in the reception areas expressed as a percentage of that in the evacuation areas showed the following progression in the four quarters of 1939 and the first two quarters of 1940 : 67, 58, 81, 119, 122, 75.

Comparing the aggregates as a whole, it is apparent that diphtheria incidence upon children under 15, as measured by the notification rates per 10,000, declined in the evacuation towns after the dispersal and increased greatly in the reception areas, but this effect was only temporary, and subsided after the first few months of 1940. In seeking an explanation for this, certain facts will need to be taken into account. In the evacuation areas the schools were closed from the summer holiday in 1939 until the middle of 1940 or after, and a small proportion were closed in neutral areas. The children left behind in the evacuation towns were consequently less exposed to infection than before owing to (1) thinning out of the population and (2) school closure. In many large towns it is customary to notify as diphtheria doubtful cases, in order to secure their removal to the infectious diseases hospital and to obtain the most enlightened diagnosis and prompt treatment if diphtheria is confirmed, and this results in the notifications being considerably in excess of the real incidence; for although provision is made for subsequent amendment of the weekly returns, this is usually not carried out by the Medical Officer of Health either in his own reports or in the figures furnished to the Registrar-General, and these represent in most areas the numbers of initial notifications. In the Plaistow Hospital, West Ham, in 1937 it was found that 21 per cent. of the notified cases admitted were not suffering from diphtheria, and in the Monsall Hospital, Manchester, in 1938 the proportion was 16 per cent. It is possible that the proportion of doubtful cases notified might have been reduced to some extent after the dispersal owing to school closure and other disturbance of normal arrangements, and that the notification rate in the evacuation areas as a whole might have declined fictitiously in consequence, but this, if it occurred, could account for only a small portion of the 48 per cent. fall recorded by the first quarter of 1940. The dispersal, official and unofficial, comprised all classes of children, and there seems no reason for supposing that it involved any important differential selection as regards liability to diphtheria.

The children who arrived in the reception areas found themselves in a less crowded environment than before, but they attended school, whereas those left behind in the evacuation towns did not. The utmost increase in incidence to be expected amongst these

Comparing first the aggregates of all neutral, evacuation and reception areas, the rates per 10,000 children for *Diphtheria* were :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	74	46	48	54	42	44
Evacuation areas	69	52	47	43	27	40
Reception areas	46	30	38	51	33	30
England and Wales ...	*61*	*41*	*43*	*49*	*36*	*36*

Expressed as percentages of the rates in the neutral areas these become :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	100	100	100	100	100	100
Evacuation areas	93	113	98	80	64	91
Reception areas	62	65	79	94	79	68

and expressed as percentages of the rates in the June quarter of 1939, just before the dispersal :

	1939				1940	
	1	2	3	4	1	2
Neutral areas	161	100	104	117	91	96
Evacuation areas	133	100	90	83	52	77
Reception areas	153	100	127	170	110	100
England and Wales ...	*149*	*100*	*105*	*120*	*88*	*88*

Normally diphtheria incidence is higher in the first and fourth quarters than in the second and third by 20 to 60 per cent., but the maximal rate sometimes occurs in the fourth quarter, as in 1936 and 1937, and sometimes in the first, as in 1938 and 1939.   The neutral areas, which included many of the northern industrial towns, recorded in general higher notification rates than either the evacuation or reception areas, and they showed in comparison with the second quarter a 17 per cent. increase in the fourth quarter of 1939, followed by a decline in the first quarter of 1940.   The evacuation areas, however, recorded a 17 per cent. fall in the quarter following the dispersal, and by the first quarter of 1940 the rate had fallen by 48 per cent.   The reception areas, normally characterized by lower rates, since they included the bulk of the rural districts, recorded a 70 per cent. increase in the diphtheria rate in

In England and Wales at mid-1938 children under 15 formed 21·5 per cent. of the total population; in Greater London the proportion was 20·1 per cent., in the county boroughs 21·9 per cent. and in other urban areas and in rural areas 21·6 per cent. Before the dispersal the proportion may be regarded as constant in all large groups of areas, viz. $P_0 = \frac{14}{3} p_0$, and since 90 per cent. of the diphtheria and scarlet-fever notifications occurred in p_0 and 10 per cent. in $P_0 - p_0$, we have:

$$p_0 r = 9(P_0 - p_0) \, r' = 9(\tfrac{14}{3} - 1) \, p_0 r' = 33 p_0 r', \text{ whence } r = 33 r'$$

After the proportions of children had been disturbed by the evacuation movements, the populations being changed to P and p, the expected proportion of notifications at ages under 15 to those at all ages would become:

$$\frac{pr}{(P - p)r' + pr} = \frac{33p}{32p + P}$$

The ratio of the number of notifications at ages under 15 to the number expected in the population under 15 had the national rate r been operative would be:

In quarters before the dispersal $\dfrac{4}{rp_0} \times \dfrac{90M}{100} = \dfrac{3\cdot6M}{rp_0}$

In quarters after the dispersal $\dfrac{4}{rp} \times \dfrac{33p}{32p + P} = \dfrac{132M}{r(32p + P)}$

and the quarterly rates of incidence per 10,000 children under 15, corrected for changes in the age constitution of the population produced by the evacuation movements, are:

In quarters before the dispersal ...   ... $\dfrac{3\cdot6 \times 10^4 M}{p_0}$

In quarters after the dispersal   ...   ... $\dfrac{132 \times 10^4 M}{32p + P}$

The values of p_0, the estimated population of children under 15 before the dispersal; the percentage change, x, in this population for the fourth quarter of 1939; the numbers of civilian notifications at all ages, M, during each of the eight quarters of 1939–40 for diphtheria and during the first six of these quarters for scarlet fever; and the corrected rates of incidence in the six quarters amongst children under 15 calculated in the manner indicated above, are shown for the various aggregates of areas in the accompanying tables.

tion of all ages in England and Wales during the 10 years 1931–40 has been as follows :

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
Diphtheria ...	1·26	1·08	1·18	1·70	1·60	1·39	1·49	1·58	1·15	1·16
Scarlet fever ...	2·05	2·12	3·21	3·76	2·96	2·53	2·33	2·41	1·89	1·59

and the seasonal variation by quarters during the normal years 1936–38, is shown below :

Year	Quarterly rate per cent. of annual rate of incidence							
	Diphtheria				Scarlet fever			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1936	111	81	82	126	120	92	77	112
1937	97	80	87	136	87	87	88	137
1938	128	81	83	109	123	100	80	98

For both diseases approximately 90 per cent. of notifications are of children under 15 years of age.*   The quarterly rates of incidence in 1939 and 1940 per 1,000 of the civilian population of all ages, and per 10,000 children under 15 on that assumption were as shown :

Ages	Year	Diphtheria				Scarlet fever			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th
All ages per 1,000 ...	1939	1·42	0·97	1·01	1·18	2·09	2·04	1·77	1·65
	1940	0·87	0·88	1·11	1·69	1·25	1·15	1·77	2·23
Under 15 per 10,000	1939	60·6	41·3	43·4	49·3	89·6	87·2	75·7	69·0
	1940	36·4	36·4	45·6	69·0	52·1	47·6	72·8	91·1

Let r = quarterly notification rate in England and Wales per 10,000 children under 15 years of age.

r' = quarterly notification rate in England and Wales per 10,000 persons aged 15 and over.

P_0 = population of an area at all ages before the dispersal of children, including p_0 at ages under 15.

P = mean civilian population of the area at all ages in a quarter after the dispersal, including p at ages under 15.

M = number of notifications of civilians in the area during the quarter.

* *Annual Report of Chief Medical Officer to the Ministry of Health,* 1937, p. 53.
Annual Report of Medical Officer of Health, County Borough of West Ham, 1937, p. 158.

estimated to have been children under 15; the mid-1939 population under 15 was taken, therefore, as $p_0 = p_1 + n + \frac{1}{3}(d - n)$.   For a reception area, if n be the number of children billeted there and d the net increase in population of all ages after allowing for enlistment and natural growth, $p_0 = p_1 - n - \frac{1}{3}(d - n)$.

This population, p_0, was used for the first three quarters of 1939. No special account was taken of the official evacuation of children of pre-school ages accompanied by their mothers, for the remnant of these who had not returned to their homes before the date of the National Register would be included in d.   The child population at the end of 1939, p_2, was estimated by adding or deducting from p_1 the change in number of school children billeted or still evacuated during the fourth quarter, estimated from the Ministry of Health returns, and the number at risk in the fourth quarter was taken as $\frac{1}{2}(p_1 + p_2)$.   The average populations during the first and second quarters of 1940 were estimated by a similar process, taking into account the drift back during the first half of the year.   Later in the year new large-scale evacuations took place from certain areas, some of which had previously been neutral.

The use of these estimates of the child population for quarterly rates of incidence of notifiable diseases involves certain errors.   In the third quarter of 1939, owing to the length of the incubation periods, some notifications must have been credited to reception areas during September relating to billeted children who had been infected before leaving their homes, and this would result in a slight degree of overstatement in the reception-area rates for that quarter. The errors involved by neglecting to allow for the transient residence of young children accompanied by their mothers in certain reception areas during September would also tend to produce some overstatement of the same kind, and the combined effect of these factors may have exaggerated the reception-area rates to an appreciable extent for the third quarter.   The best indication of the immediate change in incidence which followed the dispersal is given, therefore, by comparing the rates for the fourth quarter with those of the second quarter of 1939.

Another difficulty arises from the fact that the ages of persons notified for infectious disease are not reported to the Registrar-General (a defect in the national statistics which it is hoped at some future time to remedy), so it is necessary to estimate what proportion of the total notifications in aggregates of areas relate to children under 15.   The method of doing this is explained below.

Diphtheria and Scarlet Fever.

The incidence of notified cases of these diseases per 1,000 popula-

Since regional localization, size of town and degree of urbanization are known to be important in normal circumstances when rates of incidence of epidemic diseases are under consideration, the administrative areas were first divided into the following main groups :

	England and Wales	Greater London	Remainder of Southern regions	Midlands, East and Wales	Northern regions
London Administrative County	L	L	—	—	—
Other Great towns (population 50,000 and over and all county boroughs)	a	al	as	am	an
Small towns (population 20,000–50,000)	b	bl	bs	bm	bn
Other urban districts (population under 25,000)	c	cl	cs	cm	cn
Rural districts	d	dl	ds	dm	dn

Within each of these groups comparison has been made between evacuation (E.), neutral (N.) and reception(R.) areas. Furthermore, the reception areas have been grouped according to the ratio of school children received into the area at the beginning of the war to the estimated pre-war population at ages 5–15, Ro— indicating areas where the percentage increase at the end of September 1939 was greater than zero but less than 10, R10— indicating areas where the percentage increase was 10 but less than 20, and so on.

The populations most convenient for the comparison of rates of incidence of the diseases under review are the numbers of children under 15 years of age, and these have been estimated as follows. The population under 15 at the date of the National Register, September 29th, 1939, p_1, was obtained by multiplying the number of children in the register with birth dates in 1935–39, that is to say the population at ages 0–4¾ years, by 1·05 to obtain the number at ages under 5, and adding those born in 1925–34 (the population aged 4¾–14¾, which is a close enough approximation to the number aged 5–15 years). From returns furnished by the Ministry of Health of school children evacuated from and billeted in each area at the beginning of September 1939, and at later dates, the numbers, n, evacuated or billeted at the end of September were first estimated. If the total loss of population of all ages from an evacuation area between the end of June and end of September 1939 in excess of that expected from enlistment and natural growth be d, of whom n were the school children officially billeted elsewhere at the latter date, the total transfer of children under 15 from the area was estimated as $n + \frac{1}{3}(d - n)$, since, as stated above, about one-third of the persons who left the evacuation areas independently are

demiological enquiry into the sources of diphtheria and of scarlet fever infections, save only in very exceptional instances, is notoriously difficult, and it would appear that nothing short of intensive contemporary field investigation, coupled with extensive swabbing and bacteriological typing, might have furnished an explanation of the observed phenomena. With regard to the tentative explanation offered : to some reception areas a further evacuation took place within a few months, which time would probably not allow of a new equilibrium having been established in the area consequent on the introduction of a new type of organism with the first batch. Perhaps Dr. Stocks could see his way to re-examine his data in these areas and to see if, in fact, the second batch—which may or may not have come from the same evacuation area as the first—was followed by the same phenomena as was the first.

Mr. W. J. Martin : Dr. Stocks has had the advantage of access to data enabling him to estimate the actual exposed to risk in areas of different type. Before seeing his admirable paper, I had made an analysis of the proportional distribution of notifications of diphtheria and scarlet fever between county boroughs, other urban areas and rural districts. This is, of course, a much less satisfactory method than that of true rates, but is of interest, and can be brought down nearer to the present time.

First year of war. The outbreak of war towards the end of the third quarter of 1939 was the occasion of mass evacuation of children

		Scarlet fever				Diphtheria		
	Total cases notified	Proportion per 1,000 cases			Total cases notified	Proportion per 1,000 cases		
		C.B. s	U.D. s	R.D. s		C.B. s	U.D. s	R.D. s
1937								
1st quarter...	20,877	177	385	138	14,848	566	315	119
2nd ,, ...	20,814	474	392	135	12,341	554	334	112
3rd ,, ...	21,162	484	379	136	13,285	539	330	132
4th ,, ...	32,860	470	403	127	11,393	546	350	103
1938								
1st quarter...	30,439	448	413	139	20,746	530	363	106
2nd ,, ...	21,810	446	412	141	13,115	543	353	104
3rd ,, ...	19,780	466	399	135	13,483	525	355	120
4th ,, ...	24,203	488	380	132	17,675	488	397	113
1939								
1st quarter...	21,696	476	387	137	14,672	500	385	115
2nd ,, ...	21,214	463	395	142	10,005	534	354	112
3rd ,, ...	18,354	443	398	158	10,519	474	395	131
4th ,, ...	16,904	313	424	262	12,137	371	439	190
1940								
1st quarter...	13,369	334	408	258	9,032	438	399	163
2nd ,, ...	11,814	377	424	200	8,973	468	388	144
3rd ,, ...	17,732	395	408	197	11,196	488	380	132
4th ,, ...	22,346	406	391	203	16,984	515	360	126
1941								
1st quarter...	16,059	376	413	212	14,542	491	368	141
2nd ,, ...	13,410	354	427	219	11,634	469	369	163
3rd ,, ...	11,756	384	425	190	10,643	506	352	142

from congested to less densely populated districts. Later, encouraged by the absence of air raids, a gradual return of the evacuees to their homes began. The approach of Christmas speeded up this return, and the evacuation scheme had been seriously impaired by the second quarter of 1940. The effect of this migration upon the relative distribution of scarlet fever and diphtheria is shown in the Table. The proportion of diphtheria and scarlet fever decreased in the county boroughs, increased slightly in the urban districts, and showed a large rise in the rural areas in the fourth quarter of 1939. The proportion of scarlet fever in the rural areas increased by 66 per cent. and that of diphtheria by 45 per cent. compared with the pre- ceding quarter. This difference in the trends of the two diseases became more marked during the following year. After the with- drawal of the children from the reception areas the proportion of diphtheria fell steadily, and by the third quarter of 1940 had re- turned to the level of the third quarter of 1939. The proportion of scarlet fever in the rural areas showed only a very slight decrease during the first quarter of 1940, fell considerably during the second quarter, but remained practically unchanged in the third quarter. Thus, while the equilibrium had been restored in the case of diphtheria, there was an increase of 25 per cent. in the proportion of scarlet fever in the rural areas in the third quarter of 1940 compared with the corresponding quarter of 1939.

Second year of war. The intensification of aerial warfare caused the second large-scale evacuation of the great towns a twelve- month after the first. This re-evacuation proceeded during the end of the third quarter of 1940, and consequently it would be expected that the returns for the last quarter would show abrupt changes in the proportional distribution of scarlet fever and diphtheria similar to those observed a year earlier, if only because of the increased numbers of children in the rural areas. Very surprisingly, the proportion of diphtheria in the rural areas showed a continued decline, whilst the proportion of scarlet fever increased only slightly. In the county boroughs the proportion of scarlet fever increased by 3 per cent. during the fourth quarter compared with the third quarter. and that of diphtheria by 6 per cent. In London during the fourth quarter of 1940 there were 957 and 648 notifications of scarlet fever and diphtheria, respectively, as compared with 576 and 431 for the preceding three months. The percentage increases were 66 and 50. This is in striking contrast to the experience of the preceding year, when the notifications for London showed the large decreases of 71 and 52 per cent. for scarlet fever and diphtheria respectively. For the whole country the increase in the number of notifications during the fourth quarter of 1940 over the third quarter amounted to 26 per cent. for scarlet fever and 52 per cent. for diphtheria, whilst for the preceding year the returns for the fourth quarter showed a decline of 8 per cent. for scarlet fever and an increase of 15 per cent. for diphtheria. The conditions of life in the metropolis during the bombardment, the herding in shelters, the anxiety and loss of sleep, with the consequent lowering of the resistance to infectious disease, may reasonably explain the unfavourable experience of London during the fourth quarter of 1940.

The proportion of the two diseases in the rural areas showed an increase in both the first and second quarters of 1941; the relative increase was larger for diphtheria than for scarlet fever. The lull in the air war during the summer resulted in a drift of evacuees back to the towns and, as would be expected, since the population at risk decreased, the proportion of scarlet fever and diphtheria diminished in the rural areas during the third quarter of 1941. The proportion of scarlet fever and diphtheria in the rural areas in the third quarter of 1941 was 20 per cent. and 8 per cent. in excess of the proportion in the third quarter of 1939.

The experience of the first two war years suggests that the trend of scarlet fever is less stable than that of diphtheria, since the evacuation of children to rural areas caused a larger relative increase in the former than in the latter, and scarlet fever did not revert as quickly as diphtheria to its original proportion.

Dr. W. N. Pickles (of Aysgarth) : My observations are necessarily confined to one locality, but may perhaps be of some interest. Everyone knows that the forecasts of dramatic epidemic happenings in reception areas did not materialize, but Dr. Stocks clearly shows that the reaction was definite, if smaller than expectation. For my own district, to begin with scarlet fever and to dismiss it at once, no notifications whatever were received. The diphtheria incidence was slight, but of interest. Our children, it may be said, have no diphtheria experience (11 notifications in 10 years), but there is a high percentage of protective inoculation. An evacuee child, I heard in retrospect, began with a sore throat soon after his arrival. He was not very ill, and I was not called in. He was one of the " drifters " who had had enough of country life in less than a fortnight. He managed to convey diphtheria infection to two small boys, who, as fate would have it, had, being newcomers to the village, escaped inoculation.

It would be pleasing to attribute the failure of the infection to spread to protective inoculation, but I believe the real reason in this case was that the visitor children did not mix with the native children in the schools until the culprit had left the village.

Dr. Stocks, in reply : The one advantage I have experienced in the removal of my Department to a reception area has been the saving of time formerly dissipated in daily travelling; and this, coupled with the enforced extinction of one's normal social activities, has made it possible amid the pressure of official work to carry on a little statistical research. It seemed to me important to try to learn some of the epidemiological lessons taught by the dispersal of so many of our city children, whilst those lessons are still of practical as well as historic interest; and it was with that end in view that the analysis of the behaviour of the four epidemic diseases was started. I hoped that some useful discussion would be stimulated, and this hope has been so far realised for the first two diseases that I am greatly encouraged in proceeding with the remainder. I wish to thank all who have contributed to the discussion, not merely for the

many kind things they have said, but for the amount of thought they have devoted to the problems presented by the data.

Professor Greenwood's comments have provided an indispensable addition to the paper for which all readers will be grateful. His point that the amount of intermingling of the immigrant and native children may have diminished as the proportion of immigrants increased may go far towards explaining the paradox that the increase in diphtheria and scarlet fever incidence was almost independent of that proportion. We cannot say now from which towns the visitor children to particular localities came, except that broadly the southern reception areas received the bulk of their children from London and the northern areas from the northern cities; but it will probably be possible for post-war research workers to obtain more detailed information.

Professor Picken mentions the difficulties in estimating the populations at the different periods. Whilst it must be admitted that estimation of the mid-1939 populations involved a good many assumptions about unofficial evacuation movements during July to September of that year, once the National Register was in being the movements of population, without specification of sex or age, were derived from that and were never dependent upon food-ration-card statistics, though the latter were taken into account when they began to be compiled. I agree that notification rates may have tended towards overstatement of diphtheria in some of the reception areas, but this could not explain the evanescent rise of the diphtheria rates in the reception area groups. With regard to Professor Picken's surmise that the visitor children may in fact have shared in the increase in incidence which followed their arrival in the reception areas, I may say that in a small sample of the localities which experienced a large increase in diphtheria, and for which the necessary details have been obtained, this was not the case where the visitor children came from large cities. It is to be hoped that it will be possible at some future time to settle this important point from a larger sample of the reception areas in which increases occurred.

Dr. Glover's opinion that school attendance was probably " the main factor in differentiating the respective incidences in evacuation, neutral and reception areas " is one to which considerable weight must be given, and I am glad to find myself not alone in holding that view. More will have to be said about this matter in dealing with measles and whooping cough. I am grateful to Dr. Gale for giving us some authoritative facts about the reopening of schools in 1940 and the numbers of children receiving part and whole-time education. Increased crowding of the native children in home and school must, as Dr. Glover says, have generally followed an influx of visitor children. Professor Greenwood has pointed out that the degree of such crowding need not have increased *pari passu* with the proportion of visitor to native children, however, and if that could be established from local records of a sample of the reception areas it seems to me that closure of schools in the evacuation areas coupled with the crowding up of the native children in the reception areas could account for most of the facts revealed in the present analysis without resort to any other hypothesis.

Referring to the suggestion I made, Mr. Russell asks what is the justification for supposing that a population might be in equilibrium with one strain but not with another strain of an organism, and he asks, " Is not a child either immune from or susceptible to diphtheria ? " In its natural state a population of children consists, I believe, of individuals whose immunity levels form a continuous quantitative frequency distribution, and cannot be so simply divided into immunes and susceptibles, though artificial immunization on a large scale would greatly modify this position. The main factors concerned in the start of an epidemic are, one supposes, the number of sources of infection present; the virulence of the organism, *i.e.*, its capacity for overcoming the various defences of the body; the amount of intermingling of the sources of infection with the population; the presence in some instances of favourable seasonal conditions; and the immunity distribution in the population. A state of equilibrium with a particular organism may be regarded as any combination of these conditions such that the introduction of a few new sources of that organism does not result in an epidemic. Although the other four factors may be independent of the strain of diphtheria, virulence as above defined differs according to the strain; thus one strain produces more toxin than another. It must surely follow that the immunity level necessary to neutralize a given dose or succession of doses without resulting disease also differs according to the strain. If this is so then a population might be in temporary equilibrium with one strain but not with another—in other words the introduction of a few carriers of one strain might result in an epidemic whereas the introduction of a few carriers of another strain would not. Strong active immunization produced by contact with one strain of diphtheria presumably protects against contact with the other strains, but a latent immunity produced by a weak strain might be insufficient in some individuals to protect against subsequent contact with a more virulent strain. Furthermore in rural districts many children who have never acquired any latent immunity might be able to neutralize by their natural defences an attack by a weak strain but might succumb to an attack by a stronger one. I agree that five hundred immigrants from a town where there were carriers would be rather more likely to upset a state of equilibrium than fifty immigrants from the same town, since the latter might include no sources of infection at all, or, as in Dr Pickles' experience at Aysgarth, the spread of infection from a single source might be arrested by lack of contacts until the danger was past.

I am indebted to Mr. Russell for calling my attention to an arithmetical error in the original text.

Mr. Martin's table provides a most useful summary of the urbanrural distribution of the two diseases up to 1941. The contrast between the trends of the London and county borough rates in the fourth quarters of 1939 and 1940 seems to confirm the importance of school closure as a factor in reducing the evacuation area rates in 1939; and the absence of any increase in the rural areas at the end of 1940 is of considerable interest in view of the fact that the bulk of the immigrant children came from the same towns as in 1939.

WHOLESALE PRICES IN 1940

BY THE EDITOR OF "THE STATIST"

(The Statist's Index Numbers in continuation of
Mr. A. Sauerbeck's figures)

IN Table I below are set out the Sauerbeck-*Statist* annual index-numbers for each year from 1846 to 1940, Jevons' figures for 1810 and 1818, adjusted to Sauerbeck's standard, being also included. These index-numbers, based on averages for the period 1867–77, are calculated (with few exceptions) from the average of weekly quotations throughout each year for the forty-five commodities which they cover. Up to the end of 1912 they were calculated by the late Mr. Augustus Sauerbeck. Since that date they have been compiled by *The Statist*.

For the year 1940 the annual index for all commodities, at 128, represents a rise of 35 per cent. in the general level of wholesale prices over 1939. This movement compares with an increase, between 1938 and 1939, of 4·3 per cent., which was due, as indicated in the previous annual review, to conditions prevailing after the outbreak of war in September 1939, the previous eight months having seen a continuance of the declining wholesale price tendency which characterized the period 1937–1939. The 35 per cent. rise noted for 1940 may also be compared with the increase of 27 per cent. that occurred in the general annual index in 1915 over that for 1914, which saw the end, among other things, of a three-year period of price stability.

During 1940 the rising level of prices manifested itself unevenly, both in time and in its spread over the major groups of commodities entering into *The Statist* index. For the first half of the year that index reflected, month by month, a rise of 40 per cent. on the corresponding month in 1939. In July and August the upward movement was intensified, to 46 per cent., but from September the proportional increase of the general index over that for the preceding year fell each month, the average for the last quarter amounting to 18 per cent., compared with a steady 40 per cent. in each of the preceding quarters.

This shaping of price events was common, though in varying degrees, to the changes that overtook all the main commodity groups. In the first three quarters of the year the total food index rose, over those of 1939, by 37, 37, and 40 per cent. respectively. In the last quarter the rise on the 1939 level was 8·5 per cent. Similarly, for all industrial materials, increases of 41, 44 and 41 per cent. in the first three quarters was followed by one of 18 per cent. during October–December.

Some will see in the consistency of this pattern convincing proof of the growing effectiveness of the widening range of price controls, one effect of which—as emphasized in our previous review—is to rob price indices of much of their normal validity. Others will

observe that the comparatively restrained price movements of the final quarter of the year merely reflect the impact of war, already noted, upon the corresponding period of 1939. Looking back over a longer period, it is now easier to discern the relative force of that sudden impact, which led, in the first three months of war, to a 33 per cent. rise in the wholesale price level over that for August 1939, compared with a total rise by the end of 1940 of 49 per cent. over that month's general index.

While the general pattern of price movements, in time, was similar for the principal commodity groups, a more varied picture is presented by a comparison of their respective annual indices, given in the accompanying summary of index-numbers. On the year the combined food index advanced by 34 per cent. and the index for all industrial materials by 37 per cent. But the scale of proportional increases during 1940 ranged from a minimum of 22 per cent. in the case of minerals to 58 per cent. in that of textiles. A similar contrast, in the foods section, between the 23 per cent. rise on the year in animal foodstuffs and the 52 per cent. increase in respect of vegetable foods, points to the significance of ocean transport as a principal element in the price situation that confronted the nation in 1940.

TABLE I

THE STATIST'S *Annual Index Numbers* (*in continuation of Sauerbeck's figures*)

(1867–77 = 100)

Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.
1940	128	1920	251	1900	75	1881	85	1862	101
'39	95	1919	206	1899	68	'80	88	'61	98
'38	91	'18	192	'98	64	'79	83	'60	99
'37	102	'17	175	'97	62	'78	87	1859	94
'36	89	'16	136	'96	61	'77	94	'58	91
'35	84	'15	108	'95	62	'76	95	'57	105
'34	82	'14	85	'94	63	'75	96	'56	101
'33	79	'13	85	'93	68	'74	102	'55	101
'32	80	'12	85	'92	68	'73	111	'54	102
'31	83	'11	80	'91	72	'72	109	'53	95
'30	97	'10	78	'90	72	'71	100	'52	78
'29	115	1909	74	1889	72	'70	96	'51	75
'28	120	'08	73	'88	70	1869	98	'50	77
'27	122	'07	80	'87	68	'68	99	1849	74
'26	126	'06	77	'86	69	'67	100	'48	78
'25	136	'05	72	'85	72	'66	102	'47	95
'24	139	'04	70	'84	76	'65	101	'46	89
'23	129	'03	69	'83	82	'64	105	'18	159*
'22	131	'02	69	'82	84	'63	103	'10	171*
'21	155	'01	70						

* Jevons's numbers adjusted.

TABLE II

THE STATIST'S *Annual Index Numbers—ten-year averages*

(1867–77)

1838–1847 = 93	1900–1909 = 73	1916–1925 = 165
'48– '57 = 89	'01– '10 = 73	'17– '26 = 164
'58– '67 = 99	'02– '11 = 74	'18– '27 = 159
'68– '77 = 100	'03– '12 = 76	'19– '28 = 152
'78– '87 = 79	'04– '13 = 77	'20– '29 = 142
'88– '97 = 67	'05– '14 = 79	'21– '30 = 127
'90– '99 = 66	'06– '15 = 82	'22– '31 = 120
'91–1900 = 66	'07– '16 = 88	'23– '32 = 115
'92– '01 = 66	'08– '17 = 98	'24– '33 = 110
'93– '02 = 66	'09– '18 = 110	'25– '34 = 104
'94– '03 = 66	'10– '19 = 123	'26– '35 = 99
'95– '04 = 67	'11– '20 = 146	'27– '36 = 95
'96– '05 = 68	'12– '21 = 148	'28– '37 = 93
'97– '06 = 70	'13– '22 = 153	'29– '38 = 90
'98– '07 = 71	'14– '23 = 157	'30– '39 = 88
'99– '08 = 72	'15– '24 = 162	'31– '40 = 91

Monthly Fluctuations of the Index Numbers* of 45 Commodities, 1867–77 = 100

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1888	70·9	70·6	69·9	69·8	68·1	67·4	69·0	70·1	71·9	72·4	72·7	73·2	70
1897	62·0	61·9	61·9	61·5	61·2	61·3	61·7	63·2	63·4	62·7	62·4	62·4	62
'98	62·8	63·4	63·0	65·5	66·4	64·7	64·3	64·0	63·9	63·6	63·9	63·8	64
1899	65·4	65·8	65·6	66·1	66·6	66·9	67·9	68·3	70·0	71·5	71·6	72·3	68
1900	74·0	75·1	75·7	75·6	75·5	75·7	76·2	76·0	75·5	74·7	73·9	73·4	75
'01	72·2	71·7	71·0	70 6	70·5	69·8	69·5	69·8	69·6	69·6	69·0	68·4	70
'02	68·8	68·9	69·2	69·7	70·9	70·4	70·0	69·5	69·3	68·8	68·6	69·1	69
'03	69·5	70·2	70·4	69·4	69·6	69·5	69·5	70·0	69·1	69·0	69·0	70·0	69
1904	70·4	70·8	70·8	70·5	69·9	69·4	69·9	70·4	70·7	71·0	71·2	70·9	70
'05	71·2	71·4	71·8	72·0	71·7	72·0	72·5	72·3	72·4	73·2	74·2	74·9	72
'06	75·2	75·0	75·7	76·5	77·0	76·9	76·4	76·7	77·5	78·5	78·6	79·7	77
'07	80·0	80·7	80·0	80·7	82·4	82·0	81·1	79·4	79·1	78·8	76·7	76·2	80
'08	76·0	74·5	74·1	73·8	73·6	72·9	73·1	72·2	72·5	72·2	72·2	72·3	73
1909	72·0	71·9	72·4	74·3	75·4	75·1	75·2	74·9	74·7	75·2	75·5	76·3	74
'10	77·1	78·1	79·1	78·5	78·2	76·9	78·1	78·2	77·6	77·2	77·8	77·9	78
'11	78·5	78·6	78·9	80·0	80·3	80·0	78·9	79·5	80·3	80·7	80·6	80·9	80
'12	81·8	82·9	84·4	85·0	85·3	85·5	86·5	85·9	86·7	85·8	85·3	86·4	85
'13	86·4	86·1	86·7	86·2	85·7	84·1	84·2	85·0	85·7	84·5	83·3	83·8	85
1914	83·5	83·8	82·8	82·3	82·3	81·2	82·4	87·9	89·3	89·8	88·8	91·6	85
'15	96·4	100·9	103·7	105·9	107·2	106·4	106·4	107·0	107·8	110·0	113·1	118·4	108
'16	123·6	127·0	130·4	134·2	135·4	131·0	130·5	134·5	134·4	141·5	150·8	154·3	136
'17	159·3	164·0	169·0	173·0	175·0	180·4	176·9	175·7	176·4	180·6	182·9	185·1	175
'18	186·2	187·3	188·0	189·8	191·1	192·3	192·9	195·9	197·1	197·8	195·3	196·0	192
1919	192·1	187·5	184·7	184·6	194·6	199·4	206·4	212·7	214·8	224·3	231·0	235·2	206
'20	245·3	260·4	261·8	266·1	260·0	255·7	254·6	253·5	248·7	239·9	223·8	207·2	251
'21	197·2	183·0	177·2	169·8	162·2	155·8	158·2	154·3	149·4	138·4	136·7	133·6	155
'22	132·5	132·2	133·3	134·8	135·5	135·6	134·0	129·6	127·9	130·1	130·6	129·1	131
'23	130·2	131·9	132·7	134·0	132·2	127·9	124·8	125·0	127·8	127·7	132·4	133·2	129
1924	137·2	138·8	137·0	136·8	136·4	136·3	138·4	138·0	141·3	146·1	145·5	147·7	139
'25	144·8	143·1	140·1	137·5	135·7	131·2	134·3	134·3	132·7	130·2	132·9	130·4	136
'26	129·3	127·9	126·1	125·5	125·7	124·9	126·0	127·0	128·0	131·0	130·8	123·9	126
'27	123·1	124·1	123·6	123·3	123·8	123·1	122·0	122·8	121 5	120·6	121·5	121·4	122
'28	120·9	121·1	123·6	125·6	126·2	122·6	120·3	118·0	116·8	116·8	117·9	117·9	120
1929	117·0	120·1	120·5	116·5	113·0	113·1	115·2	113·9	112·6	111·1	108·3	108·8	115
'30	106·6	104·8	103·0	101·5	98·8	95·8	94·4	92·2	90·8	90·4	88·6	86·9	97
'31	85·7	85·5	85·5	84·4	82·2	82·6	80·2	79·1	80·7	82·3	83·0	85·4	83
'32	84·7	86·7	84·1	82·5	80·2	77·0	78·9	80·7	80·4	77·8	77·9	77·7	80
'33	77·8	77·0	77·0	78·5	80·9	81·3	81·7	81·2	80·7	80·5	79·3	80·0	79
1934	82·5	82·5	82·2	81·0	81·1	80·7	82·4	83·4	82·1	81·1	81·0	82·8	82
'35	83·6	83·4	82·9	84·1	85·2	83·7	84·3	84·1	85·1	85·8	86·3	86·7	84
'36	87·1	87·1	86·7	86·2	85·6	84·8	87·1	89·0	90·4	91·7	94·5	98·9	89
'37	99·6	102·1	107·3	104·7	106·2	104·7	105·9	104·4	103·3	100·8	96·7	97·3	102
'38	96·5	96·4	94·2	93·5	91·4	91·4	91·1	88·6	88·6	88·8	87·4	89·1	91
'39	88·7	88·6	89·0	90·5	90·6	90·6	88·7	90·4	99·7	105·8	112·2	120·1	95
'40	124·1	124·5	123·4	126·0	128·0	130·0	129·5	131·5	131·6	131·8	132·7	134·5	128
'41	134·9	136·3	138·0	141·1	143·5	144·4	145·3	145·1	145·5	143·7			

* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

Summary of Index Numbers.   Groups of Articles, 1867–77 = 100

	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver *	Wheat Harvest †	Average Price of Consols ‡	Average Bank of England Rate ‡
												£	Percent
1873......	106	109	106	107	141	103	106	114	111	97·4	80	92½	4·750
1896......	53	73	59	62	63	54	63	60	61	50·5	112	110¾	2·483
1911......	70	90	61	75	93	76	81	83	80	40·4	110	79 5/16	3·467
1915......	108	126	70	110	126	92	109	108	108	38·9	106	65¼	5·000
'16......	133	152	86	130	158	129	136	140	136	50·4	97	58 3/16	5·470
1917......	177	192	113	169	172	192	174	179	175	65·8	102	54¼	5·15
'18......	168	207	130	174	192	222	202	206	192	76·4	111	56⅞	5·0
'19......	179	213	147	185	220	228	219	222	206	85·3	98	54 1/16	5·166
'20......	227	263	198	234	295	262	244	264	251	76·1	96	47 7/16	6·71
'21......	143	218	83	158	181	140	145	153	155	48·1	118	47 9/16	6·092
1922......	107	184	82	130	142	134	124	132	131	51·6	105	56 13/16	3·692
'23......	98	162	101	122	155	140	117	134	129	49·4	105	57 7/16	3·496
'24......	119	158	105	130	158	170	120	146	139	50·7	107	56 6/16	4·0
'25......	118	162	89	128	154	165	119	143	136	52·5	114	56⅜	4·575
'26......	108	150	88	119	154	133	114	131	126	47·1	99	54 9/16	5·0
1927......	108	138	83	114	141	131	118	129	122	42·8	109	54 13/16	4·650
'28......	107	142	78	114	123	136	117	124	120	44·0	109	55 1/8	4·5
'29......	99	146	72	110	126	122	111	119	115	40·2	114	54 5/16	5·508
'30......	77	142	54	96	112	84	97	97	97	29·0	99	56	3·4
'31......	68	119	50	83	100	63	85	82	83	20·4	99	55 7/16	3·975
1932......	72	105	50	79	99	64	81	81	80	19·5	105	66 7/16	3·017
'33......	60	106	47	74	107	67	80	83	79	18·7	114	73 11/16	2·0
'34......	63	108	50	77	109	72	80	85	82	20·0	120	80 11/16	2·0
'35......	66	107	42	76	112	80	83	90	84	26·4	112	86½	2·0
'36......	76	109	41	81	118	83	88§	94	89	18·5	100	85 11/16	2·0
'37......	93	117	49	93	142	93	101	110	102	18·4	99	76 1/16	2·0
'38......	81	111	43	84	136	75	87	96	91	17·6	122	74 5/16	2·0
'39......	74	115	47	83	137	93	90	103	95	17·1	112	66 21/64	2·5
'40......	112	141	58	111	167	147	120	141	128	17·1	—	72 1/16	2·0
Average													
1904–13	68	91	53	73	95	74	76	81	77	44·1	106	82 4/16	3·733
1890–99	61	80	63	68	71	56	66	64	66	55·8	103	103 1/16	2·958
'78–87	79	95	76	84	73	71	81	76	79	82·1	97	99 9/16	3·264
1818–27	109	90	151	111	128	105	106	112	111	98·0	—	—	3·692

* Silver (see note on p. 352), parity of 1 gold to 15¼ silver = 100.
† Wheat harvest in U.K to 1895 : 29 bushels = 100 ; from 1896 : 30 bushels = 100.
‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2¾% from 1889, 2½% from April, 1903.

THE STATIST'S *Index Numbers—monthly averages by groups*
(1867–77 = 100)

	Vegetable Food	Animal Food	Sugar, Tea, and Coffee	Food-stuffs	Minerals	Textiles	Sundry Materials	Total Materials	All Commodities
1938									
Jan. ...	95·0	115·2	44·2	91·7	135·0	79·4	92·8	100·0	96·5
Feb. ...	92·0	117·1	42·7	90·9	136·2	78·6	93·7	100·5	96·4
Mar. ...	89·9	116·9	42·3	89·8	133·3	75·5	90·6	97·4	94·2
April ...	89·1	116·9	42·4	89·5	132·3	75·3	89·1	96·5	93·5
May ...	89·1	114·3	42·3	88·5	129·6	72·3	85·9	93·5	91·4
June ...	89·5	111·1	42·0	87·5	134·2	72·8	84·6	94·3	91·4
July ...	83·5	109·6	42·0	84·4	136·0	75·1	85·7	96·0	91·1
Aug. ...	76·2	106·9	42·9	80·5	134·6	73·3	84·6	94·5	88·6
Sept. ...	74·3	105·7	43·7	79·4	137·1	73·4	84·8	95·4	88·6
Oct. ...	70·7	104·1	43·0	77·2	141·1	74·4	85·9	97·2	88·8
Nov. ...	67·0	103·6	43·0	75·4	140·6	73·1	84·6	96·1	87·4
Dec. ...	68·7	109·6	44·0	78·6	140·0	75·4	84·8	96·8	89·1
1939									
Jan. ...	68·9	110·9	43·3	79·0	134·8	78·0	84·0	95·9	88·7
Feb. ...	67·7	110·0	43·1	78·2	133·8	80·1	83·9	96·2	88·6
Mar. ...	67·3	111·7	44·1	78·8	133·9	80·7	84·2	96·5	89·0
April ...	66·7	113·2	47·0	79·7	135·1	85·4	84·7	98·5	90·5
May ...	66·3	112·6	46·6	79·2	134·3	85·5	86·2	99·0	90·6
June ...	67·0	113·0	47·0	79·8	133·9	86·3	84·9	98·5	90·6
July ...	61·6	110·6	43·4	76·0	134·3	84·5	84·6	97·9	88·7
Aug. ...	62·2	112·8	44·4	77·1	136·2	87·0	86·6	100·2	90·4
Sept. ...	71·9	127·6	56·5	89·1	136·9	101·7	92·8	107·4	99·7
Oct. ...	85·6	130·3	56·0	95·8	138·1	108·0	100·9	113·1	105·8
Nov. ...	92·3	130·3	58·5	99·2	143·4	124·1	106·4	121·8	112·2
Dec. ...	101·7	130·3	57·6	103·0	158·7	138·4	111·8	132·6	120·1
1940									
Jan. ...	106·2	142·7	57·3	109·4	158·1	142·9	114·1	134·8	124·1
Feb. ...	103·7	140·5	57·5	107·5	161·0	140·8	118·6	136·8	124·5
March ...	102·6	140·5	57·3	107·0	161·2	139·9	115·5	135·3	123·4
April ...	102·7	140·5	57·6	107·0	163·4	145·6	121·1	140·0	126·0
May ...	104·2	140·5	56·9	107·6	166·6	150·7	122·0	142·9	128·0
June ...	117·2	140·5	56·4	113·0	165·7	148·9	123·4	142·6	130·0
July ...	106·5	140·5	58·1	108·8	172·1	150·0	123·1	144·6	129·5
Aug. ...	122·5	140·5	57·8	115·5	170·9	147·5	121·9	142·7	131·5
Sept. ...	122·9	140·5	59·8	116·1	170·2	148·4	121·5	142·9	131·6
Oct. ...	124·6	140·5	59·9	116·8	171·1	150·6	119·1	142·8	131·8
Nov. ...	126·6	140·5	57·6	117·2	173·8	152·1	119·4	144·1	132·7
Dec. ...	131·3	140·5	59·0	119·5	175·5	152·9	121·0	145·5	134·5
1941									
Jan. ...	131·3	140·5	59·1	119·5	176·8	152·9	122·0	146·3	134·9
Feb. ...	130·4	140·5	62·0	119·7	179·2	152·5	125·9	148·4	136·3
March ...	127·7	142·8	64·6	120·0	181·0	159·0	126·2	151·1	138·0
April ...	135·4	142·8	65·0	123·3	180·9	159·7	132·8	154·1	141·1
May ...	138·4	142·8	65·6	124·7	181·5	161·5	138·7	157·2	143·5
June ...	140·0	142·8	65·3	125·3	181·1	163·7	140·2	158·4	144·4
July ...	143·3	142·8	64·4	126·5	182·3	164·5	140·2	159·0	145·3
Aug. ...	145·3	142·8	66·1	127·7	180·5	166·0	137·1	157·7	145·1
Sept. ...	146·5	142·8	65·7	128·1	180·3	166·2	138·2	158·2	145·5
Oct. ...	147·0	142·8	69·0	129·0	181·0	164·8	130·0	154·4	143·7

Quarterly Movements of Prices *

Summary of Index Numbers, 1867–77 = 100

Years	Quarters	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver †
1929	I	102·9	142·7	75·4	111·8	130·2	130·7	116·6	124·6	119·2	42·8
	II	92·8	148·3	73·2	109·1	125·0	121·2	111·1	117·9	114·2	41·1
	III	99·9	143·4	71·7	110·0	126·9	115·6	111·1	116·7	113·9	39·6
	IV	91·3	145·2	64·2	105·4	122·9	107·9	108·7	112·3	109·4	37·3
'30	I	80·8	152·1	58·3	102·3	121·1	96·4	104·9	106·7	104·8	33·0
	II	76·7	142·4	56·5	96·5	110·8	92·4	99·5	100·4	98·7	29·8
	III	77·4	132·1	48·6	91·5	109·0	77·3	94·6	94·6	92·5	26·8
	IV	71·9	130·0	51·7	89·0	105·4	68·9	91·6	88·3	88·6	26·5
'31	I	69·0	127·3	48·6	86·2	103·4	62·7	89·8	85·1	85·6	21·8
	II	69·5	123·3	48·8	85·0	98·6	61·4	85·6	81·7	80·1	21·3
	III	70·0	117·4	47·0	81·4	98·5	58·6	81·6	79·0	83·0	21·9
	IV	75·7	107·9	53·7	82·9	102·2	66·9	85·4	84·1	83·6	21·5
'32	I	80·7	109·2	52·2	83·2	101·1	67·5	87·8	85·2	85·2	21·0
	II	77·6	107·6	50·2	82·9	95·1	59·4	79·6	77·3	79·9	19·4
	III	68·2	105·3	49·6	77·9	100·6	65·9	80·7	81·5	80·0	19·4
	IV	64·2	98·2	48·4	73·4	101·2	64·5	80·2	81·0	77·8	18·4
'33	I	60·2	106·0	47·3	74·4	99·7	62·0	79·1	79·4	77·3	18·2
	II	59·1	108·4	47·4	74·8	109·7	68·7	79·8	84·2	80·2	20·0
	III	62·0	105·8	47·9	75·2	111·0	71·0	80·0	85·6	81·2	18·5
	IV	58·5	106·4	47·4	73·8	110·9	67·7	79·7	84·4	79·9	18·5
'34	I	59·4	110·1	53·0	76·7	111·7	73·6	79·9	86·5	82·4	19·1
	II	58·7	110·3	52·2	76·1	108·4	70·8	79·1	84·4	80·9	18·6
	III	71·0	109·5	48·0	80·4	108·5	70·7	78·7	84·3	82·6	19·7
	IV	66·7	107·3	44·8	77·0	109·7	70·9	79·6	85·0	81·6	22·1
'35	I	64·4	111·2	41·3	76·8	108·9	77·4	82·6	88·0	83·3	23·0
	II	67·1	107·9	42·3	76·9	112·3	79·4	82·8	89·8	84·3	29 3
	III	68·8	106·6	40·6	76·8	113·8	80·1	82·3	90·1	84·5	27·3
	IV	70·7	104·1	41·8	76·9	116·7	83·6	84·9	93·0	86·3	25·7
'36	I	72·1	104·6	41·2	77·6	116·1	84·6	86·4	93·8	87·0	18·2
	II	71·2	107·1	39·7	77·8	114·7	79·4	84·8	91·2	85·5	18·6
	III	75·3	112·6	39·1	81·5	116·7	80·5	90·0	94·2	88·8	18·6
	IV	85·8	110·7	42·6	85·9	129·6	88·2	93·8	101·7	95·0	18·7
'37	I	93·1	112·7	47·1	90·6	144·3	97·4	102·3	112·0	103·0	18·6
	II	94·3	121·0	49·6	94·7	143·5	99·9	102·9	112·8	105·2	18·7
	III	93·3	121·4	50·2	94·6	147·7	94·6	101·4	111·8	104·5	18·4
	IV	95·5	116·3	47·2	93·0	136·3	81·2	95·6	102·1	98·3	18·0
'38	I	92·3	116·4	43·1	90·8	134·8	77·8	92·4	99·3	95·7	18·5
	II	89·2	114·1	42·2	88·5	132·0	73·5	86·5	94·8	92·1	17·4
	III	78·0	107·4	42·9	81·4	135·9	73·9	85·0	95·3	89·4	17·3
	IV	68·8	105·8	43·3	77·1	140·6	74·3	85·1	96·7	88·4	17·4
'39	I	68·0	110·9	43·3	78·7	134·2	79·6	84·0	96·2	88·8	17·7
	II	66·7	112·9	46·9	79·6	134·4	85·7	85·3	98·7	90·6	17·3
	III	65·2	117·0	48·1	80·7	135·8	91·1	88·0	101·8	92·9	15·7
	IV	93·2	130·3	57·4	99·3	146·7	123·5	106·4	122·5	112·7	17·8
'40	I	104·2	141·2	57·4	108·0	160·1	141·2	116·1	135·6	124·0	16·3
	II	108·0	140·5	56·7	109·2	165·2	148·4	122·2	141·8	128·0	16·7
	III	117·3	140·5	58·6	113·5	171·1	148·6	122·2	143·4	130·9	17·6
	IV	127·5	140·5	58·8	117·8	173·5	151·9	119·8	144·1	133·0	17·9

* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

Construction of the Tabular Statements

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867–77. Take, for instance, the *Gazette* price of English wheat :—

```
                         s.   d.
Average, 1867–77  ...   54   6 = 100, average point.
   „      1914    ...   35   0 =  64, or 36 per cent. below the average point.
   „      1930    ...   80   7 = 148,  „ 48    „      above    „        „
   „      1936    ...   53   3 =  98,  „  2    „      below    „        „
```

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories :—

	Index Nos.	1867–77 Total Numbers	Example for 1940	
			Total Numbers	Average
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice)	8	800	898	112
2. Animal food (beef, mutton, pork, bacon, and butter)	7	700	985	141
3. Sugar, coffee, and tea	4	400	232	58
1–3. *Food*	19	1,900	2,115	111
4. Minerals (iron, copper, tin, lead, and coal)	7	700	1,169	167
5 Textiles (cotton, flax, hemp, jute, wool, and silk)	8	800	1,176	147
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber)	11	1,100	1,316	120
4–6. *Materials*	26	2,600	3,661	141
General Average	45	4,500	5,776	128

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetic mean as shown above.

Index of Silver Prices

The base of the index numbers given below is 60·84*d.* per standard oz. = 100, this being a parity of 1 fine oz. of gold to 15½ standard ozs. of silver.*

	Price per oz. standard	Index number		Price per oz. standard	Index number
	d.			*d.*	
Average 1873 ...	59¼	=97·4	*Lowest* Nov., 1902	21 11/16	=35·6
,, '90–99...	34	=55·8	End Dec., 1906 ...	32 5/16	=53·1
,, 1917–26...	40½	=66·6	,, Dec., '08 ...	23 7/16	=38·1
,, 1893 ...	35⅔	=58·6	,, Dec., '12 ...	29	=47·7
,, '96 ...	30¾	=50·5	,, Dec., '13 ...	26 1/16	=43·7
,, 1909 ...	23 11/16	=38·9	,, June, '14 ...	26	=42·7
,, '14 ...	25 5/16	=41·6	,, Dec., '14 ...	22 11/16	=37·3
,, '15 ...	23 11/16	=38·9	,. Dec., '15 ...	26¼	=43·1
,, '16 ...	31 1/16	=50·4	,, Dec., '16 ...	36½	=58·7
,, '17 ...	40⅞	=65·8	,, Dec., '17 ...	43½	=70·0
,, '18 ...	47½	=76·4	,, Dec., '18 ...	48 7/16	=77·9
,, '19 ...	57	=85·3	,, Dec., '19 ...	77¼	=98·3
,, '20 ...	61 9/16	=76·1	,, Dec., '20 ...	40⅞	=49·2
,, '21 ...	36⅞	=48·1	,, Dec., '21 ...	34⅝	=40·3
,, '22 ...	34 11/16	=51·6	,, Dec., '22 ...	31 1/16	=49·6
,, '23 ...	31 11/16	=49·4	,, Dec., '23 ...	33 1/16	=49·0
,, '24 ...	34	=50·7	,, Dec., '24 ...	31 13/16	=50·4
,, '25 ...	32⅛	=52·5	,, Dec., '25 ...	31 11/16	=52·1
,, '26 ...	28 11/16	=47·1	,, Dec., '26 ...	25	=41·1
,, '27 ...	26 7/16	=42·8	,, Dec., '27 ...	26½	=43·6
,, '28 ...	26¾	=44·0	,, Dec., '28 ...	26⅜	=43·3
,, '29 ...	24 7/16	=40·2	,, Dec., '29 ...	21 7/16	=35·2
,, '30 ...	17 11/16	=29·0	,, Dec., '30 ...	14 7/16	=23·7
,, '31 ...	14¾	=20·4	,, Dec., '31 ...	20 7/16	=21·6
,, '32 ...	17½	=19·5	,, Dec., '32 ...	16½	=17·2
,, '33 ...	18¼	=18·7	,, Dec., '33 ...	19 1/16	=19·5
,, '34 ...	21 7/32	=20·0	,, Dec., '34 ...	24⅝	=22·6
,, '35 ...	29	=26·4	,, Dec., '35 ...	22¼	=20·6
,, '36 ...	20 1/16	=18·5	,, Dec., '36 ...	21 5/16	=19·4
,, '37 ...	20 1/16	=18·4	,, Dec., '37 ...	19 1/16	=17·7
,, '38 ...	19 11/16	=17·6	,, Dec., '38 ...	20 7/16	=17·3
,, '39 ...	20 11/16	=17·1	,, Dec., '39 ...	22¼	=17·3
,, '40 ...	22 11/64	=17·1	,, Dec., '40 ...	23 5/16	=17·9

* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86*s.* 9½*d.* per fine oz., derived from the " pegged " New York rate of $4·76½ to the £. For 1919 the average price of gold is taken as 93*s.* 4½*d.*, this being the parity price with the U.S. dollar, the average New York exchange in that year being $4·429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109*s.* 8¼*d.* per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116*s.* 1*d.*, 98*s.* 0*d.*, 88*s.* 11*d.*, 95*s.* 4*d.*, and 88*s.* 2*d.* respectively and the average quotations in these years were 112*s.* 11½*d.*, 107*s.* 0½*d.*, 93*s.* 4*d.*, 90*s.* 3*d.*, and 93*s.* 8¼*d.* respectively, while the average price in 1925 was 85*s.* 5½*d.* The prices at the end of 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939 and 1940 were 121*s.* 11*d.*, 123*s.* 9*d.*, 126*s.* 6*d.*, 141*s.* 0*d.*, 141*s.* 2*d.*, 141*s.* 7*d.*, 139*s.* 6*d.*, 149*s.* 7½*d.*, 168*s.* and 168*s.* respectively, and the average prices in these years were 92*s.* 6½*d.*, 118*s.* 0½*d.*, 124*s.* 10½*d.*, 137*s.* 7¾*d.*, 124*s.* 1¼*d.*, 140*s.* 3½*d.*, 140*s.* 8¾*d.*, 142*s.* 6½*d.*, 154*s.* 4*d.* and 168*s.* respectively.

World's Production of Silver (in millions of ounces)

		United States	Mexico	Canada	Australia	Other Countries	Total
1904...	...	57·7	60·8	3·7	14·5	27·5	164·2
'05...	...	56·1	65·0	5·9	15·0	30·3	172·3
'06...	...	56·5	55·2	8·5	14·2	30·6	165·0
'07...	...	56·5	61·0	12·8	19·0	34·8	184·2
'08...	...	52·4	73·6	22·1	17·2	37·8	203·1
'09...	...	54·7	73·9	27·5	16·3	39·7	212·1
'10...	...	57·1	71·4	32·9	21·5	38·8	221·7
'11...	...	60·4	79·0	32·7	16·6	37·5	226·2
'12...	...	63·8	74·6	31·6	18·1	36·2	224·3
'13...	...	66·8	70·7	31·5	3·5	51·4	223·9
'14...	...	72·4	27·5	28·4	3·6	36·5	168·4
'15...	...	74·9	39·5	28·4	4·1	37·3	184·2
'16...	...	74·4	38·2	25·4	4·2	26·6	168·8
'17...	...	71·7	35·0	22·2	10·0	35·3	174·2
'18...	...	67·8	62·5	21·2	10·0	35·9	197·4
'19...	...	56·7	62·7	15·7	7·4	32·0	174·5
'20...	...	55·5	66·8	12·6	7·5	33·0	175·4
'21...	...	53·1	64·5	13·1	4·9	35·7	171·3
'22...	...	56·2	81·1	18·6	11·3	46·3	213·5
'23...	...	73·3	90·9	17·8	13·3	50·7	246·0
'24...	...	65·3	91·5	19·7	10·8	52·2	239·5
25...	...	66·1	92·9	20·2	11·1	54·8	245·1
'26...	...	62·7	98·3	22·4	11·2	59·0	253·6
'27...	...	60·4	104·6	22·7	9·0	57·3	254·0
'28...	...	58·4	108·5	21·9	9·0	59·5	257·3
'29...	...	61·2	108·7	23·1	9·0	59·7	261·7
'30...	...	51·0	105·0	26·0	8·9	57·1	248·0
'31...	...	31·0	86·0	21·0	7·6	50·4	196·0
'32...	...	24·0	69·0	18·0	6·5	47·5	165·0
'33...	...	22·8	68·1	15·2	11·0	52·0	169·1
'34...	...	32·5	74·1	16·4	10·8	56·6	190·4
'35...	...	45·6	75 6	16·6	11·4	71·5	220·7
'36...	...	63·4	77·5	18·3	12·7	81·8	253·7
'37...	..	71·3	84·7	22·7	14·3	80·9	273·9
'38...	...	61·7	81·0	22·2	103·0		267·9
'39...	...	57·8	81·0	24·7	103·3		266·8
'40*	...	66·0	84·5	25·0	102·5		278·0

* Provisional.   (Estimate by Messrs. Samuel Montagu & Co.)

(000's omitted)

Year				Value of output £	Year				Value of output £
1851	...	...	...	17,200	1896	...	...	...	41,559
'52	...	...	...	26,550	'97	...	...	...	48,509
'53	...	...	...	31,090	'98	...	...	...	58,949
'54	...	...	...	25,490	'99	...	...	...	63,027
'55	...	...	...	27,015	1900	...	...	...	52,312
'56	...	...	...	29,520	'01	...	...	...	53,630
'57	...	...	...	26,655	'02	...	...	...	60,975
'58	...	...	...	24,930	'03	...	...	...	67,337
'59	...	...	...	24,970	'04	...	...	...	71,380
'60	...	...	...	23,850	'05	...	...	...	78,143
'61	...	...	...	22,760	'06	...	...	...	82,707
'62	...	...	...	21,550	'07	...	...	...	84,857
'63	...	...	...	21,390	'08	...	...	...	90,995
'64	...	...	...	22,600	'09	...	...	...	93,302
'65	...	...	...	24,040	'10	...	...	...	93,544
'66	...	...	...	24,220	'11	...	...	...	94,930
'67	...	...	...	22,805	'12	...	...	...	95,783
'68	...	...	...	21,945	'13	...	...	...	97,481
'69	...	...	...	21,245	'14	...	...	...	92,709
'70	...	...	...	21,370	'15	...	...	...	97,114
'71	...	...	...	25,400	'16	...	...	...	92,597
'72	...	...	...	24,200	'17	...	...	...	87,236
'73	...	...	...	23,600	'18	...	...	...	78,605
'74	...	...	...	22,950	'19	...	...	...	73,078
'75	...	...	...	22,700	'20	...	...	...	68,522
'76	...	...	...	22,540	'21	...	...	...	67,848
'77	...	...	...	23,830	'22	...	...	...	66,723
'78	...	...	...	22,020	'23	...	...	...	77,888
'79	...	...	...	21,400	'24	...	...	...	81,807
'80	...	...	...	22,130	'25	...	...	...	82,267
'81	...	...	...	21,150	'26	...	...	...	82,211
'82	...	...	...	20,500	'27	...	...	...	82,582
'83	...	...	...	20,640	'28	...	...	...	82,400
'84	...	...	...	20,830	'29	...	...	...	84,500
'85	...	...	...	21,250	'30	...	...	...	88,500
'86	...	...	...	21,430	'31	...	...	...	95,100
'87	...	...	...	21,735	'32	...	...	...	103,400
'88	...	...	...	22,644	'33	...	...	...	107,700
'89	...	...	...	25,375	'34	...	...	...	116,000
'90	...	...	...	24,421	'35	...	...	...	125,700
'91	...	...	...	26,846	'36	...	...	...	140,900
'92	...	...	...	30,134	'37	...	...	...	148,200 *
'93	...	...	...	32,363	'38	...	...	...	158,300 *
'94	...	...	...	37,229	'39	...	...	...	164,800 *
'95	...	...	...	40,843	'40 (provisional)			...	172,100

* Amended figures.

Gold.—The table shows the world's annual gold production since 1851. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The estimates since 1926 are those of the Union Corporation, Limited. The value is taken throughout at £4·25 per fine oz.

Average Prices of Commodities *

No. of Article	0	1	2	3	4	5	6	7	8	1–8	9	10
		Wheat		Flour	Barley	Oats	Maize §	Potatoes *	Rice	Vegetable Food	Beef ‡	
Year	Silver †	English *Gazette*	American	Town Made white(now "G.R.")	English *Gazette*	English *Gazette*	American Mixed	Good English	Rangoon Cargoes to Arrive	Total	Prime	Mid-dling
	d. per oz.	*s.* and *d.* ½ er qr.	*s.* and *d.* per qr.	*s.* per sack (280 lbs.)	*s.* and *d.* per qr.	*s.* and *d.* per qr.	*s.* per qr.	*s.* per ton	*s.* and *d.* per cwt.		*d.* per 8 lbs.	*d.* per 8 lbs.
1873 ...	59½	58·8	63	51	40·5	25·5	30	160	9·6	—	65	56
1920 ...	61¹⁰⁄₁₆	80·7	92·4	66	90	57·4	90⅔	242½	41·10	—	125	125
'21 ...	36⅞	72·9	73·9	64½	54·4	34·5	38¼	198	18·5	—	115	109⅞
'22 ...	34⁷⁄₁₆	47·10	52·11	45¾	40·1	29·1	31½	130	14·10	—	88⅝	82
'23 ...	31⅝	42·2	47·3	39½	33·8	26·8	36	101	14·10	—	79¼	74¼
'24 ...	34	49·3	53·9	43½	46·9	27·2	39¾	186	16·9	—	82⅛	76⅛
'25 ...	32⅝	52·2	62·4	50⅜	42·0	27·2	38₁⁄₁₆	154	16·0	—	80	73½
'26 ...	28¹¹⁄₁₆	53·3	58·9	49¼	36·11	25·1	29¹²⁄₁₆	127	16·3	—	74	67
'27 ...	26₁⁄₁₆	49·3	58·3	44⁹⁄₁₆	42·0	25·4	30⁶⁄₁₆	136	15·11	—	70	62
'28 ...	26¾	44·8	50·10	40⅛	39·0	29·0	38¹³⁄₁₆	133	15·0	—	74	66⅝
'29 ...	24⁷⁄₁₆	42·2	51·3	38½	35·5	24·7	36¼	111	14·3	—	71	66
'30 ...	17¹¹⁄₁₆	34·3	36·10	33₁⁄₁₂	28·3	17·2	23	93	13·0	—	73	68
'31 ...	14⅞	24·0	25·1	22⅞	28·0	17·8	15⁷⁄₁₀	146	9·8	—	67	61
'32 ...	17⁷⁄₁₆	25·0	27·5	24₅⁄₁₂	27·1	19·3	18¹³⁄₁₆	152	9·8	—	65	59
'33 ...	18⅛	22·10	25·7	23¹²⁄₁₂	28·7	15·10	17₁⁄₁₀	86	7·9	—	61	52
'34 ...	21⁷⁄₁₆	20·2	28·0	23⅛	30·11	17·5	19¹⁵⁄₁₆	97	7·8	—	58	52
'35 ...	29	22·2	31·1	25¾	28·7	18·9	17½	107	8·10	—	54	49
'36 ...	20₁⁄₁₆	30·9	35·1	31¹¹⁄₁₂	29·5	17·8	19½	146	9·0	—	54	50
'37 ...	20⁷⁄₁₆	40·0	49·7	40¼	39·0	23·11	26⁶⁄₁₆	136	10·5	—	61	57
'38 ...	19½	28·11	39·3	30⅛	36·4	21·2	28⁷⁄₁₆	111	10·7	—	62	58
'39 ...	20⅛	21·5	30·1	22⁹⁄₁₂	31·7	19·3	26½	117	11·1	—	61	58
'40 ...	22⅛	42·10	33·6	24⁵⁄₁₆	64·10	37·2	39¹³⁄₁₆	143	15·5	—	72	68
Average												
1904–13	26¾	31½	36	30	25¼	18¼	24¼	78	7¾	—	51	44½
1890–99	34	28½	31½	27½	25¼	17½	19½	72	6¼	—	47	37½
'78–87	50	40	43½	34½	31¼	21	25	102	8	—	55½	46
'67–77	58½	54½	56	46	39	26	32½	117	10	—	59	50
Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100												
1873 ...	97·4	108	113	104	104	98	92	137	95	851	110	112
1920 ...	76·1	148	165	143	231	221	279	207	418	1,812	212	250
'21 ...	48·1	133	132	140	139	132	118	169	184	1,147	195	220
'22 ...	51·6	88	95	100	103	112	96	111	148	853	150	164
'23 ...	49·4	77	84	86	86	103	111	86	148	781	134	149
'24 ...	50·7	90	96	95	120	105	122	159	167	954	139	152
'25 ...	52·5	96	111	109	108	105	119	132	160	940	136	147
'26 ...	47·1	98	105	107	95	96	92	109	163	865	125	134
'27 ...	42·8	90	104	98	108	97	95	116	159	867	119	124
'28 ...	44·0	82	91	87	100	112	118	114	150	854	125	133
'29 ...	40·2	77	91	84	91	95	112	95	143	788	120	132
'30 ...	29·0	63	66	72	72	66	71	79	130	619	124	136
'31 ...	20·4	44	45	50	71	68	48	125	93	544	114	122
'32 ...	19·5	46	49	53	69	74	58	130	93	572	110	118
'33 ...	18·7	42	46	52	73	61	53	74	78	479	103	104
'34 ...	20·0	37	50	50	79	67	60	83	77	503	98	104
'35 ...	26·4	41	56	56	73	72	53	91	88	530	92	98
'36 ...	18·5	56	63	69	75	68	60	125	90	606	92	100
'37 ...	18·4	73	89	88	100	92	82	116	105	745	103	114
'38 ...	17·6	53	70	67	93	81	86	95	106	651	105	116
'39 ...	17·1	39	54	48	81	74	82	100	111	589	103	116
'40 ...	17·1	78	60	53	166	143	122	122	154	898	122	136

* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.
† Not included in the general average.   ‡ Meat (9—13), by the carcase, in the London Central Meat Market.
§ La Plata from 1924.

Average Prices of Commodities—Contd.

No. of Article	11	12	13	14	15	9–15	16A	16B	17	18A	18B	18
	Mutton		Pork	Bacon	Butter		Sugar			Coffee		
Year	Prime	Mid-dling	Large and Small, average	Water-ford	Fries-land, Fine to Finest	Animal Food Total	British West Indian Refining ‖	Beet, German, 88 p. c., f.o.b.	Java, Floating Cargoes §	Ceylon Planta-tion, Low Middling †	Rio, Good	Mean of 18A and 18B
	d. per 8 lbs.	d. per 8 lbs.	d. per 8 lbs.	s. per cwt.	s. per cwt.		s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
1920 ...	144⅔	144⅔	168¼	239⅔	301	—	58	65½‡	74¾	148	111½	—
'21 ...	130⅞	125¼	121¾	179	250	—	19½	18½‡	22	120¾	63	—
'22 ...	125	121½	101	145⅓	202½	—	15	14⅝	15⁶⁄₁₆	120⅝	74⅛	—
'23 ...	114¾	107⅜	89	113¼	186	—	25½	23½	24⅔	117½	55	—
'24 ...	111¼	103¼	70	106	211	—	23⅝	20¼	21½	152⅝	85¼	—
'25 ...	106⅓	98⅝	84¼	128⅛	206⅞	—	16¼	11⁰⁄₁₆	12½	153	98	—
'26 ...	89	80¼	98⅝	130	173	—	16⁷⁄₁₆	11⅜	12⅝	154⅔	89	—
'27 ...	86	79⅝	85	102½	178	—	16⁷⁄₁₆	12½	13	143½	71½	—
'28 ...	92¼	87	77	101⅜	185⅞	—	13¼	10¹¹⁄₁₆	11½	143	81	—
'29 ...	89½	83	91	116	180⅓	—	11	8	8	141	74	—
'30 ...	92	86	89	105⅝	146	—	8⅝	5	6	106	42	—
'31 ...	79	73	65	83⅜	130	—	7¹³⁄₁₆	5¹¹⁄₁₆	6⅞	101¼	53	—
'32 ...	63	55	54	77	126¾	—	7⅛	5⁵⁄₁₆	5¹¹⁄₁₆	105	54	—
'33 ...	69	63	60	81½	105	—	7	4¾	5¼	86	42	—
'34 ...	74	70	65	90	79	—	6	4	4	87	42	—
'35 ...	75	70	62	89	92⅝	—	6	3	4	67	29	—
'36 ...	73	68	65	93	98	—	6	3	4	58	30	—
'37 ...	78	74	68	94	108	—	7	5	6	75	36	—
'38 ...	62	56	69	97	114	—	7	4	5	75	19	—
'39 ...	68	64	70	97	122	—	9	6	7	73	22	—
'40 ...	85	76	96	114½	143	—	9¾	—	8	86	28	—
Average												
1904–13	58¼	51¾	47⅝	67	113	—	10¼	10⅞	12	75½	43¾	—
1890–99	54½	41½	42¾	59	100	—	11½	11½	13¾	98	62	—
'78–87	64½	53	49	71	116	—	17	18	21½	78	52	—
'67–77	63	55	52	74	125	—	23	24	28¾	87	64	—
Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100												
1873 ...	113	114	104	109	98	760	101		98	115*	134*	125
1920 ...	230	263	324	324	241	1,844	263		262	170	174	172
'21 ...	208	228	234	242	200	1,527	81		77	140	98	119
'22 ...	199	221	194	196	162	1,286	62		54	140	116	128
'23 ...	182	196	171	154	149	1,135	104		87	135	86	111
'24 ...	177	188	135	143	169	1,103	93		75	175	133	154
'25 ...	169	180	162	174	165	1,133	60		43	176	154	165
'26 ...	141	146	190	176	138	1,050	60		44	178	139	159
'27 ...	136	145	163	138	142	967	62		47	165	112	139
'28 ...	146	158	148	137	149	996	51		40	165	127	146
'29 ...	142	151	175	157	144	1,021	42		31	162	117	140
'30 ...	146	155	171	143	117	992	31		22	123	66	95
'31 ...	125	133	125	113	104	836	29		23	120	53	87
'32 ...	100	100	104	104	101	737	27		20	121	85	103
'33 ...	110	114	115	110	84	740	25		18	100	66	83
'34 ...	117	127	125	122	64	757	22		16	100	67	84
'35 ...	119	127	119	120	74	749	21		17	78	46	62
'36 ...	116	124	131	127	79	763	21		17	67	48	58
'37 ...	124	135	125	127	86	820	28		23	87	57	72
'38 ...	98	102	133	131	92	777	24		19	86	31	59
'39 ...	108	116	135	132	98	808	32		26	85	35	60
'40 ...	135	138	185	155	114	985	42		29	99	44	72

* Index numbers not included in general average.   ‡ Comparative values.
† E. India good middling from 1908.   § Raw Centrifugals, 96% Pol., from 1924.   ‖ White Javas, C.I.F., from 1924.

Average Prices of Commodities—Contd.

No. of Article.	19A* Congou, Common	19C* Indian, Good Medium	19B* Average Import Price	19 Mean of 19A and 19B	16–19 Sugar, Coffee, and Tea Total	1–19 Food Total	20A Scottish Pig	20B Cleveland (Middlesbrough) Pig	21 Bars, Common	22 Standard	English Tough Cake	23 Straits
Year		Tea						Iron		Copper		Tin
	d. per lb.	d. per lb.	d. per lb.				s. and d. per ton	s. and d. per ton	per ton	£ per ton	£ per ton	£ per ton
1873 ...	12	—	16·67	—	—	—	117·3	—	12½	84	92	132
1920 ...	11¼‡	9⅝	14·97	—	—	—	214·11	208·11	28⅗	97⅓	112¾	302
'21 ...	4¾	7	12·4	—	—	—	168·6	137·4	19½	69½	72¾	171
'22 ...	8⅝	13¾	14·9	—	—	—	99·10	90·7	11½	63¼	66⅓	162
'23 ...	11	17 1/16	17·58	—	—	—	108·0	108·9	11¼	65 9/16	69 1/16	206
'24 ...	9½	17½	19·0	—	—	—	96·8	88·2	12¼	63 5/16	67 7/16	251
'25 ...	7⅞	14 15/16	18·34	—	—	—	83·4	72·8	11⅞	61 13/16	65¼	267
'26 ...	7 13/16	16 15/16	18·82	—	—	—	87·2	87·6	11½	58 1/16	63 5/16	297 7/16
'27 ...	6¾	14⅞	18·58	—	—	—	80·5	73·0	11¼	55¾	60 1/16	303¾
'28 ...	6 5/16	12¼	16·84	—	—	—	69·9	65·9	9 1/16	63¾	66 1/16	229 7/16
'29 ...	6 1/16	11 7/16	16·11	—	—	—	74·0	70·3	9¼	75 9/16	78 13/16	207 1/16
'30 ...	5 7/16	9¼	15·12	—	—	—	76·0	67·0	9 11/32	54¾	58 1/16	144 13/16
'31 ...	4 1/16	6 1/16	13·29	—	—	—	71·0	58·6	10 5/16	38⅝	39 5/16	121¼
'32 ...	4 9/16	5½	10·75	—	—	—	68·2	58·6	10	31 21/32	33 15/16	140
'33 ...	6 11/16	8 3/16	11·87	—	—	—	66	62·3	9 11/16	32 21/32	34 15/16	202½
'34 ...	8 11/16	12	13·20	—	—	—	69·6	66·11	9 15/16	30 5/16	32 21/32	232¼
'35 ...	6 13/16	10 11/16	13·06	—	—	—	70·6	67·10	9⅝	32 15/16	34 1/16	230 15/16
'36 ...	6¼	11⅛	13·19	—	—	—	78·6	73·2	10 3/16	37 13/16	41 23/32	207 21/16
'37 ...	6 9/16	13 1/16	14·58	—	—	—	104·6	94·4	12⅝	54 23/32	59⅛	246⅛
'38 ...	6 13/16	11¾	14·04	—	—	—	118·0	109	13¼	41 23/32	45⅝	193 31/32
'39 ...	6 1/16	11 5/16	14·18	—	—	—	104·3	100·7	12⅝	44¼	—	232 17/32
'40 ...	—	—	15·33	—	—	—	114·10	116·4	14 1/16	62	—	273 1/16
Average												
1904–13	7⅞	7⅓	8¼	—	—	—	57¾	51½	6⅞	67¼	72	164⅞
1890–99	4⅝	7½	9⅜	—	—	—	47	41½	5½	50	53	81
'78–87	6¾	—	12¾	—	—	—	46	38	5¼	55	60	89
'67–77	11¼	—	17¼	—	—	—	69	60	8¼	75	81	105

Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100

Year	19A*	19C*	19B*	19	16–19	1–19	20A	20B	21	22	Eng. Tough Cake	23
1873 ...	107	—	97	102	426	2,037	170	—	152	112	—	126
1920 ...	100	—	88	94	791	4,447	329		343	130	—	288
'21 ...	39	—	72	55	332	3,006	237		232	92	—	163
'22 ...	77	—	86	82	326	2,465	148		136	84	—	154
'23 ...	98	—	102	100	402	2,318	168		144	88	—	196
'24 ...	82	—	110	96	418	2,475	143		152	84	—	239
'25 ...	70	—	106	88	356	2,429	121		144	82	—	254
'26 ...	69	—	109	89	352	2,267	135		139	77	—	283
'27 ...	60	—	108	84	332	2,166	119		136	74	—	289
'28 ...	56	—	98	77	314	2,164	105		120	85	—	219
'29 ...	54	—	93	74	287	2,096	112		118	101	—	198
'30 ...	46	—	88	67	215	1,826	111		121	73	—	138
'31 ...	42	—	78	60	199	1,579	100		123	52	—	115
'32 ...	38	—	62	50	200	1,509	98		121	43	—	131
'33 ...	58	—	68	63	189	1,408	99		117	44	—	193
'34 ...	77	—	77	77	199	1,459	106		116	40	—	221
'35 ...	60	—	76	68	168	1,447	107		117	43	—	219
'36 ...	56	—	76	66	162	1,531	118		123	50	—	198
'37 ...	58	—	85	72	195	1,760	154		149	73	—	235
'38 ...	58	—	81	70	172	1,600	176		161	56	—	185
'39 ...	56	—	82	69	187	1,584	159		150	59	—	221
'40 ...	—	—	89	89	232	2,115	179		173	83	—	260

* Index numbers not included in the general average.   † Approximate.   ‡ Nominal.   § First 9 months only.

Average Prices of Commodities—Contd.

No. of Article / Year	24 Lead — English Pig £ per ton	25A Coal — Wallsend Hetton in London § s. per ton	25B Coal — Newcastle Steam s. per ton	26 — Average Export Price s. per ton	20–26 Minerals — Total	27 Cotton — Middling American d. per lb.	28 Cotton — Fair Dhollerah ‖ d. per lb.	29A Flax — Petrograd ¶ £ per ton	29B Flax — Russian Average Import Price £ per ton	30A Hemp — Manila Fair Roping £ per ton.	30B Hemp — Petrograd Clean (a) £ per ton	31 Jute — Good Medium †† £ per ton
1873	23½	32	—	20·90	—	9	6$\frac{5}{16}$	47½	44	43	36	18
1920	40	32	51⅛	79·8	—	23·14	13⅜	120‡	345½	65¾	145½	44⅘
'21	24¼	32¼	29	34·83	—	9·4	5$\frac{3}{4}$	112½	118½	40¼	145‡	27⅝
'22	25⅓	34⅖	24⅝	24·16	—	12·10	8	95	84⅖	33⅓	57¼	30¾
'23	28$\frac{13}{16}$	32$\frac{13}{16}$	28	23·38	—	15·25	10	83⅜	84½	33¼	57	26
'24	35$\frac{13}{16}$	27⅜	22$\frac{13}{16}$	23·38	—	16·26	11·03	120	104½	44	81	31¾
'25	37$\frac{7}{16}$	29⅝	16$\frac{15}{16}$	20·08	—	12·64	11·01	92½	120¾	46⅛	89¼	49$\frac{7}{16}$
'26	32⅛	**30$\frac{7}{14}$	**16$\frac{8}{14}$	18·59	—	9·40	7·75	65	72$\frac{1}{16}$	43	74⅝	43⅞
'27	25$\frac{1}{16}$	23$\frac{1}{10}$	14$\frac{11}{16}$	17·80	—	9·54	8·27	95$\frac{1}{16}$	74$\frac{1}{16}$	43⅜	66$\frac{5}{16}$	32¾
'28	22$\frac{1}{16}$	21$\frac{1}{16}$	13$\frac{31}{32}$	15·67	—	10·92	8·66	98⅓	91⅛	37¼	63$\frac{1}{12}$	33$\frac{1}{12}$
'29	24$\frac{1}{32}$	23⅜	15$\frac{31}{32}$	16·13	—	10·26	7·73	76$\frac{7}{10}$	71$\frac{1}{32}$	37$\frac{1}{32}$	61	32
'30	19½	24$\frac{31}{32}$	14$\frac{7}{32}$	16·64	—	7·49	5·12	53⅜	60$\frac{3}{32}$	26½	48$\frac{7}{32}$	20
'31	14$\frac{9}{32}$	24⅝	13¾	15·98	—	5·90	4·60	36	35$\frac{9}{10}$	18¾	27½	15$\frac{11}{10}$
'32	13$\frac{5}{10}$	23$\frac{1}{16}$	13½	16·27	—	5·24	4·85	45$\frac{7}{12}$	42$\frac{3}{5}$	18$\frac{11}{12}$	36	16$\frac{1}{12}$
'33	13¼	22⅜	13$\frac{31}{32}$	16·08	—	5·54	4·53	51$\frac{11}{12}$	48$\frac{11}{12}$	15⅞	37	14¾
'34	12$\frac{11}{16}$	20¼	14$\frac{5}{32}$	16·08	—	6·70	4·80	60$\frac{1}{16}$	50$\frac{29}{32}$	14$\frac{8}{12}$	42$\frac{5}{11}$	14$\frac{5}{8}$
'35	16	20$\frac{9}{32}$	14$\frac{13}{16}$	16·30	—	6·71	5·42	79⅗	72$\frac{1}{10}$	19$\frac{11}{12}$	43¼	16$\frac{1}{16}$
'36	19$\frac{13}{16}$	23$\frac{5}{16}$	15$\frac{5}{32}$	16·98	—	6·71	5·12	63$\frac{11}{12}$	60$\frac{15}{16}$	28$\frac{1}{13}$	42$\frac{31}{32}$	19$\frac{11}{16}$
'37	24$\frac{29}{32}$	24½	20$\frac{31}{32}$	19·05	—	6·21	4·80	78⅓	70$\frac{8}{32}$	34$\frac{5}{16}$	38⅜	19$\frac{11}{16}$
'38	17$\frac{7}{16}$	25$\frac{11}{16}$	18⅓	21·32	—	4·93	3·67	66$\frac{29}{32}$	63⅛	21$\frac{5}{12}$	38$\frac{1}{15}$	17$\frac{31}{32}$
'39	17⅝	25$\frac{11}{12}$	—	21·12	—	5·95	4·41	90$\frac{11}{12}$	72$\frac{1}{10}$	22$\frac{5}{10}$	48$\frac{5}{10}$	26$\frac{11}{12}$
'40	26¼	28$\frac{1}{16}$	—	27·23	—	8·10	6·26	177$\frac{11}{32}$	183$\frac{3}{32}$	26⅝	100$\frac{1}{3}$	27¾
Average												
1904–13	15⅝	18¼	11⅞	11⅞	—	6⅛	5	32½	36⅞	30⅜	31⅜	18⅞
1890–99	12	17½	10⅜	10⅜	—	4¼	3	27	27	26¼	25	12½
'78–87	14	16½	8⅝	9	—	6	4½	33	34	35½	26½	15
'67–77	20½	22	12⅓	12½	—	9	6¾	46	48	43	35	19

Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100

Year	24	25A	25B	26	20–26	27	28	29		30		31
1873	117	145	—	167	989	100	92	97		101		95
1920	195	145	—	638	2,068	257	203	495		270		236
'21	118	147	—	279	1,268	104	86	246		237		145
'22	123	156	—	193	994	134	118	191		116		162
'23	139	147	—	201	1,083	169	148	179		116		137
'24	175	125	—	187	1,105	181	163	239		160		167
'25	183	135	—	161	1,080	140	163	227		174		261
'26	157	138	—	149	1,078	104	115	147		151		231
'27	125	105	—	142	990	106	123	181		141		172
'28	109	97	—	125	860	121	128	203		130		178
'29	117	106	—	129	881	114	114	157		126		168
'30	95	113	—	133	784	83	76	121		96		105
'31	71	112	—	127	700	66	68	76		58		84
'32	65	106	—	130	694	58	72	93		70		85
'33	65	103	—	129	750	62	67	.106		68		78
'34	61	92	—	129	765	74	71	119		73		74
'35	78	92	—	130	786	74	80	161		80		89
'36	95	105	—	136	825	74	76	133		91		93
'37	121	111	—	152	995	69	71	158		93		104
'38	83	117	—	171	949	55	54	139		77		93
'39	85	115	—	169	958	66	65	174		91		140
'40	129	127	—	218	1,169	90	93	383		163		146

* Approximate prices.   † Approximate.   ‡ Nominal.   § Best Yorkshire house after 1916.
‖ Now No. 1 Oomra, Fine.   ¶ Livonian Z.K. from 1921.   ** Average price January–April, 1926.
†† Lightnings from 1931.   (a) Russian Siretz Group 1, Sort 1 from 1931-33; Jugo-Slav Peasant from 1934.

Average Prices of Commodities—Contd.

No. of Article	32A	32B	33	34	27–34	35A	35B	35C	36A	36B	37
	Wool			Silk		Hides			Leather		Tallow
Year	Merino, Port Phillip, Average Fleece	Merino, Adelaide, Average Greasy	English, Lincoln Half Hogs	Tsatlee †	Textiles Total	River Plate, Dry	River Plate, Salted	Average Import Price	Dressing Hides	Average Import Price	Town
	d." per lb.	d. per lb.	d. per lb.	s. per lb.		d. per lb.	d. per lb.	d. per lb.	d. per lb.	d. per lb.	s. per cwt.
1873 ...	25	11¼	24½	21¾	—	11	8¼	—	18¼	—	44
1920 ...	79⅞	32	22	38⅝	—	20½	18¼	20·1	43⅝	71¼	75
'21 ...	31⅞	11⅝	8⅝	26 9/16	—	9 1/16	8⅞	9·58	25⅛	46¼	36¼
'22 ...	39	17⅛	9¼	28¼	—	9⅝	8⅞	8·06	24⅛	36	36⅝
'23 ...	43 11/16	20½	12	24¼	—	9 1/16	8 1/16	8·23	23 7/16	31 7/16	36⅝
'24 ...	53 7/16	25½	18⅝	23 7/16	—	10 3/16	8⅝	8·63	22 13/16	33⅞	42¾
'25 ...	41 1/16	17⅞	17⅝	18¼	—	11 7/16	8 13/16	9·87	23	33	42¼
'26 ...	36½	16 7/16	15	15 13/16	—	10 5/16	8	9·32	21¼	35 11/16	38⅛
'27 ...	38 1/16	17 7/16	15 11/16	15 7/16	—	12 7/16	10 7/16	9·85	22 13/16	36 13/16	33⅞
'28 ...	37	17 5/16	17 13/16	14	—	15 7/16	11 13/16	12·09	23 13/16	37 7/16	36 1/16
'29 ...	35¾	13 13/16	16 1/16	13⅞	—	10 7/16	8¼	10·80	19¼	38¼	36 1/16
'30 ...	18 9/16	8 11/16	10¼	10 15/16	—	6 13/16	6¼	7·80	18½	33⅛	28 13/16
'31 ...	14·7	7·1	8½	8 1/16	—	5½	5 9/16	6·12	17½	32½	19½
'32 ...	15·0	7·2	5 13/16	8 5/16	—	4 9/16	4 11/16	5·47	17 7/16	28⅞	21 1/16
'33 ...	19·9	9·3	5 7/16	6⅜	—	5¼	4 13/16	5·65	17 11/16	26 3/16	19 13/16
'34 ...	21¼	10·4	7	5 7/16	—	4 11/16	4⅞	5·71	17½	25 7/16	17⅞
'35 ...	20·1	9·5	7 11/16	5 13/16	—	5 7/16	5⅜	5·51	17½	25 13/16	24⅝
'36 ...	24·7	12·2	10 5/16	5 13/16	—	6¼	6	6·47	17½	27 11/16	23 9/16
'37 ...	26·9	12·7	16·9	8 7/16	—	8 9/16	7 9/16	8·62	18 9/16	28 7/16	23 13/16
'38 ...	18·6	8·9	11·9	7 13/16	—	6 13/16	5 9/16	6·35	14⅝	24 13/16	17 13/16
'39 ...	17·9	9·0	12·2	13 3/16	—	6¾	6⅜	6·39	18 7/16	23 1/16	16 13/16
'40 ...	27·7	13·2	18·6	17½	—	8	8½	8·50	25 7/16	23¼	22 13/16
Average											
1904–13	17⅞	9	10⅞	11¾	—	9⅝	7½	6⅞	16	17	31¼
1890–99	13¼	6¼	10	11¼	—	6¼	5¼	5	13¼	13¾	25
'78–87	18¼	8⅜	11¾	15	—	8⅝	6¾	6¼	15	17	35½
'67–77	21¼	9⅝	19¾	23	—	9	7	6⅞	16	18¾	45

Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100

Year	32A	32B	33	34	27–34	35	36	37
1873 ...	118	—	124	95	822	120	114	97
1920 ...	359		111	168	2,099	257	330	167
'21 ...	140		44	115	1,117	123	205	81
'22 ...	180		49	125	1,075	114	174	77
'23 ...	206		61	105	1,121	113	158	81
'24 ...	254		96	102	1,362	119	163	94
'25 ...	188		87	79	1,319	132	161	94
'26 ...	170		76	69	1,063	121	164	85
'27 ...	177		78	67	1,045	142	172	75
'28 ...	174		91	61	1,086	172	176	82
'29 ...	156		81	60	976	129	166	81
'30 ...	86		54	48	669	92	150	64
'31 ...	70		43	39	504	77	146	43
'32 ...	71		29	35	513	66	132	47
'33 ...	94		30	29	534	68	127	44
'34 ...	102		35	24	572	67	123	39
'35 ...	96		37	24	641	69	125	55
'36 ...	119		53	25	646	82	129	52
'37 ...	127		86	37	745	109	134	52
'38 ...	88		60	35	601	81	110	39
'39 ...	86		62	57	741	84	119	36
'40 ...	131		94	76	1,176	109	141	49

* Port Philip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.
† Common New Style from 1921 to 1936. China, Extra "A" from 1937.

Average Prices of Commodities—Contd.

No. of Article	38	39	40A	40B	41 Petroleum *	42	43	44	45A	45B	35—45	20—45	1—45
		Oil		Seeds		Soda		Indigo	Timber		Sundry Materials	Materials	
Year	Palm	Olive	Linseed	Linseed	Refined	Crystals	Nitrate of Soda	Bengal, Good Consuming	Hewn, Average Import Price.	Sawn or Split, Average Import Price	Total	Total	Grand Total
	£ per ton	£ per ton	£ per ton	s. per qr.	d. per gall.	s. per ton	s. per cwt.	s. per lb.	s. per load	s. per load			
1873 ...	38	43	32	62	15¼	100	15½	6¾	65	62	—	—	—
1920 ...	69½	200†	88⅛	157	25½	150⅝	24¾	14½	119⅓	261⅞	—	—	—
'21 ...	36¹⁵⁄₁₆	80†	31¹⁵⁄₁₆	72⅞	22¹⁄₁₆	140	18¹⁵⁄₁₆	11⁷⁄₁₀	68¾	156¹⅜	—	—	—
'22 ...	34½	75½†	39¼	75½	15⁵⁄₁₆	123	14½	9⅝	46⅝	117½	—	—	—
'23 ...	36½	66⁹⁄₁₀	42¹⁵⁄₁₆	77⅞	13	103	13⁷⁄₁₆	7½	48	131⅛	—	—	—
'24 ...	40⁹⁄₁₆	79¹⁵⁄₁₆	42⅝	81⁹⁄₁₆	13⅛	101¾	13⅝	6¹⁄₁₀	49⁷⁄₈	122	—	—	—
'25 ...	40⅝	73⅔	43¼	80⁵⁄₁₆	13⅛	100	13⅜	5¾	47¹³⁄₁₆	122¹⁵⁄₁₆	—	—	—
'26 ...	37⅝	79⁹⁄₁₀	32⅜	63⁷⁄₁₆	13	100	13½	5⅝	48³⁹⁄₁₆	107	—	—	—
'27 ...	34¼	102⅝	31⅜	64⁵⁄₁₆	13	100	12⁷⁄₁₀	5⅜	45⁷⁄₁₀	107¹⁹⁄₁₀	—	—	—
'28 ...	35½	80⁷⁄₁₀	29⅞	66¹⁵⁄₁₆	11¹¹⁄₁₆	100	10¹⁄₁₂	5½	45⅝	111⁶⁄₁₀	—	—	—
'29 ...	34⅝¹	72	35¹⁵⁄₃₂	74⅞	12½	100	10¼	5½	44¾	107³¹⁄₃₂	—	—	—
'30 ...	25¼	52⅛	36⅝	61¹⁵⁄₁₆	12½	100	9⅝⁷⁄₈	5½	44½	102⁴⁄₁₆	—	—	—
'31 ...	19⁷⁄₁₆	53⁹⁄₁₆	18³⁄₁₆	38⅝	11¼	100	9¼	5½	37¹⁹⁄₁₂	83⅜	—	—	—
'32 ...	17⅝	57⅝¹	17	38⁵⁄₁₀	10½	100	8⅜	5½	35¼	75¹⁄₁₀	—	—	—
'33 ...	15¹¹⁄₁₆	53¹⁵⁄₁₆	20¾	39¼	10¼	100	8¹¹⁄₁₆	5½	31⅞	75¹⁹⁄₁₆	—	—	—
'34 ...	13¹⁷⁄₁₆	62⁹⁄₁₆	21¹⁹⁄₁₀	42⅝	10¹⁄₁₆	100	7¹³⁄₁₆	5½	31⅛	79¹⁵⁄₁₆	—	—	—
'35 ...	19⅝	61¹⁵⁄₁₆	24¹³⁄₁₂	43¼	10½	100	7⅝	5½	32¼	73⁵⁄₁₀	—	—	—
'36 ...	19³¹⁄₁₄	70⁹⁄₁₆	28⅛	48⁵⁄₁₆	10³⁄₁₀	100	7⅝	5¾	37⁹⁄₁₆	78⁹⅞	—	—	—
'37 ...	22⁹⁄₁₆	95³⅞	31⅛	54¹⁄₁₆	10⅜	100	7²⅝	5⅜	58⅝	103⁷⁄₃₂	—	—	—
'38 ...	14⅞	68¹⁵⁄₁₆	26⁷⁄₁₆	46⅝	10⅞	100	8	5¾	61⅞	94⅝	—	—	—
'39 ...	14⁴⁄₁₆	73¹⁵⁄₁₆	29⅛	49³⁄₁₆	11¹⁄₁₆	100	8½	5½	57¹⁄₁₀	107⁹⁄₁₀	—	—	—
'40 ...	19	114¼	44⁷⁄₁₀	66½	14³¹⁄₁₆	100	9¾	5¾	106¹⁹⁄₁₆	169¹⁵⁄₁₆	—	—	—
Average 1904–13	31¼	43⅜	26⅝	49½	6⅝	60	10⅝	3	38	56	—	—	—
1890–99	24½	35	19¼	38	5¼	53	8¼	4⅜	40	45	—	—	—
'78–87	32⅓	40	23	46	6⅞	62	12⅓	6	47	47	—	—	—
'67–77	39	50	30	60	12½*	92	14	7¼	60	54	—	—	—
Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100													
1873 ...	97	86	258		122	109	110	92	111		1,163	2,974	5,011
1920 ...	179	400	272		203	164	177	200	335		2,684	6,851	11,298
'21 ...	95	160	116		177	152	135	158	198		1,600	3,985	6,991
'22 ...	89	151	127		122	134	102	128	143		1,361	3,430	5,895
'23 ...	93	133	134		104	112	96	103	157		1,284	3,488	5,806
'24 ...	103	160	138		105	111	97	84	151		1,325	3,792	6,267
'25 ...	104	147	137		105	109	96	79	150		1,314	3,713	6,142
'26 ...	96	159	106		104	109	95	78	137		1,254	3,395	5,662
'27 ...	88	205	107		104	109	90	76	134		1,302	3,337	5,503
'28 ...	92	161	108		94	109	78	76	138		1,286	3,232	5,396
'29 ...	89	144	122		102	109	73	76	134		1,225	3,082	5,178
'30 ...	65	104	110		102	109	70	76	129		1,071	2,524	4,350
'31 ...	51	108	63		90	109	65	76	106		934	2,138	3,717
'32 ...	45	114	61		84	109	62	76	97		893	2,100	3,609
'33 ...	40	108	67		82	109	60	76	94		875	2,159	3,567
'34 ...	35	124	71		80	109	56	76	97		877	2,214	3,673
'35 ...	50	123	75		84	109	54	76	92		912	2,339	3,786
'36 ...	51	140	85		81	109	54	79	102		964	2,453	3,984
'37 ...	58	192	95		86	109	56	79	142		1,112	2,852	4,612
'38 ...	38	137	81		87	109	57	79	136		954	2,504	4,104
'39 ...	37	148	88		88	109	58	79	145		991	2,690	4,274
'40 ...	49	228	122		117	109	70	79	243		1,316	3,661	5,776

* Petroleum average, 1873–77.   † Nominal.

REPORT OF THE COUNCIL

For the FINANCIAL YEAR *ended December 31st, 1940, and for the*
SESSIONAL YEAR *ending June 24th, 1941, presented at the* ONE
HUNDRED AND SEVENTH ANNUAL GENERAL MEETING *of the*
ROYAL STATISTICAL SOCIETY, *held at the London School of*
Hygiene and Tropical Medicine, W.C.1, on June 24th, 1941.

THE Council have the honour to submit their One Hundred and
Seventh Annual Report.

The roll of Fellows on December 31st, 1940, as compared with
the average of the previous ten years, was as follows :—

Particulars.	1940.	Average of the previous Ten Years.
Number of Fellows at end of previous year ...	1108	1054
Number lost by death, withdrawal, or default ...	76	57
Fellows elected or restored to the list	47	60
Number of Fellows on December 31st	1079	1057

In addition, there were 11 Honorary Fellows.

The Council regret to report that during the sessional year ended
June 24th, 1941, the Society lost by death their President, Mr.
Henry William Macrosty, O.B.E., B.A., and the undermentioned
Fellows :—

Fellows

	Date of Election.
Appleton, William Archibald	1930
cdp*Bonar, James, M.A., LL.D., D.Litt., F.B.A. ...	1885
De Whalley, William Robert Murad	1930
*cd*Hadfield, Sir Robert A., Bart., F.R.S.	1892
*Pryor, Edward T.	1896
Ramsay, John M.	1912
cdp†*Stamp of Shortlands, the Rt. Hon. Lord, G.C.B., G.B.E., D.Sc., F.B.A.	1911
Wilde, Leonard	1922
Wilson, Lt.-Col. Sir Arnold Talbot, K.C.I.E., C.S.I., C.M.G., D.S.O., M.P.	1920
Young, Matthew, M.D., D.Sc., D.P.H.	1934

Honorary Fellow

Pearl, Raymond	1925

* Life Fellow.   † Guy Medallist.
c Served on Council.   *d* Donor to the Library.
              p Contributed to Proceedings.

Beside the name of the President the record of deaths includes that of Lord Stamp, a past President, of whose many services to the Society and to statistics Fellows will not need to be reminded, and that of Dr. James Bonar, a member of the Council for many years and a Vice-President during several sessions. Biographical notices of Mr. Macrosty, of Lord Stamp, of Dr. Bonar, and of Professor Raymond Pearl, Honorary Fellow, were published in the *Journal*.

In consequence of the death, in office, of the President, an extraordinary Meeting of the Council was summoned, under Bye-law no. 15, in order to elect a President to hold office until the next annual meeting. The Council unanimously elected Mr. Hector Leak as President during the period ending in June, 1941.

During the session 1940–41, the following 47 candidates have been elected Fellows of the Society :—

Adler, Major L. D., B.Sc., M.B., Ch.B., D.P.H.
Anscombe, Francis John.
Barker, Elsie Alice.
Brown, Arthur Joseph.
Brown, Herbert Philip Christopher.
Bulley, Walter Eric, B.A. (Com.).
Burton, Kenneth John, F.I.A.
Bushnell, Lawrence William Watson.
Campbell, George. B.Sc.
Datta, Natindra Mohan, B.A., B.Sc.
Freeman, H. A.
Hagenbuch, Walter, B.A. (Com.).
Hodgetts, Eric Ernest.
Horsefield, John Keith.
Huber, Margaret, B.Sc.
James, Arthur Casley.
Jeffcock, William Philip.
Jones, Tudor John.
Kempthorne, Oscar.
Klemmer, Harvey.
Lingwood, Frederick James.
Lipscomb, Alfred George James.

Mahoney, Frederick Strathmore.
Massey, Philip Hubert, B.Sc. (Econ.).
Maton, Juanita Mary.
Morton, J. E., LL.D.
Murphy, Leslie Frederick, B.Sc.
Nicholson, John Leonard, B.Sc.
Nicholson, Thomas William James.
Page, Arthur, Ph.D.
Penman, William, M.B.E., F.I.A.
Phillips. Ronald Hugh Stowell.
Prager, Theodor.
Raynes, Harold Ernest, F.I.A.
Robertson, Thomas St. Andrew.
Rudkin. Leslie Stuart.
Sarkar, Nihar Kamar.
Saunders, Christopher Thomas, M.A.
Spencer, Robert John.
Thomas, Gordon Glyn.
Titmuss, Richard Morris.
Tyrrell, Jean Sydney, B.Sc.
Wild, Eric, F.C.A.
Wiseman, Werner, B.Sc., F.R.Met.S.

Corporate Representatives.

Fasnacht, George Eugene,	*representing*	Nuffield College Social Reconstruction Survey.
Griffiths, Patrick Gill.	*representing*	Engineering Components, Limited.
Macpherson, Ian,	*representing*	Messrs. Buckmaster and Moore.

The number of Fellows is now 1,053, compared with 1,071 in June 1940.

As in the preceding session, it was decided not to hold Ordinary Meetings during the winter months. Therefore, to the great regret of the Council, the Society was not able to hear Mr. Macrosty's Presidential Address, which was not read but was printed in the *Journal*, Part I, 1941.

Ordinary Meetings were held in April, May, and June, 1941, while, as in the previous year, other papers which had been accepted for reading were published in the *Journal* with comment contributed in writing. The full list of papers is as follows :—

MACROSTY, H. W. Official Statistics: Retrospect and Prospect (Presidential Address).
RHODES, E. C. Secular Changes in Death Rates.
KENDALL, M. G. The Financing of British Agriculture.
GREENWOOD, PROFESSOR M., MARTIN, W. J., and RUSSELL, W. T. Deaths by Violence, 1837–1937.
<div align="right">(Read on April 15th, 1941.)</div>
WILSON, SIR DUNCAN. Factory Inspection: a Thirty-five Years' Retrospect.
<div align="right">(Read on May 20th, 1941.)</div>
GEORGE, C. OSWALD. British Public Finance in Peace and War.
<div align="right">(Read on June 24th, 1941.)</div>

The procedure adopted in the previous session with respect to candidates for election was continued. That is, approval by the Executive Committee was held to confer the substantial privileges of Fellowship pending formal election at a meeting. The 34 candidates so approved during the period July 1940 to April 1941, were duly elected at the April meeting.

The Industrial and Agricultural Research Section have not held any meetings and it was found impossible to collect the whole of the material for the first issue of the Supplement in time for it to appear, as had been intended, in 1940. Volume VII is accordingly being dated 1940–41 and the first number was issued early in this year.

The Study Group has again not been able to hold any meetings.

In the year ended May 31st, 1941, 618 works were added to the Library, compared with 1,315 the year before. These figures exclude periodicals regularly received and a number of Parliamentary Papers. During the same period 1,298 volumes were borrowed by 510 Fellows, against 2,112 by 772 Fellows the year before. The Society's Library has again been extensively used by various Government Departments.

The Council decided to suspend the award of the Guy Medal for the present, but to take into account, in considering the next award, all papers contributed since 1938.

The offer of the Frances Wood Memorial prize, which would normally have been announced in 1941, was postponed until further notice.

The abstract of the Treasurer's Accounts, viz., a Statement of Income and Expenditure for the year 1940 and the Balance Sheet as at December 31st, 1940, together with the report of the Auditors thereon, are given in Appendices A and B respectively.

There was an excess of Income over Expenditure for the year 1940 amounting to £116, as compared with £241 in 1939. Ordinary Income, at £2,836, fell by £425; this is mainly to be attributed to a fall of £224 in income from the sales of the *Journal*, to the non-publication of the Supplement in 1940, and to a decline of £203 in Fellows' subscriptions. In the present conditions such decreases are unavoidable. Ordinary Expenditure, at £2,720, fell by £300, mainly owing to decreases of £76 in Salaries and Wages, of £83 in expenses of Meetings, and of £133 in Publication and Distribution Expenses. The Accumulated Fund of the Society amounted to £7,757 at the end of 1940.

The Fellows named below (nominated in accordance with Bye-law 14) are recommended for election as President, Council, and Officers of the Society for the Session 1941–42 :—

President

Sir William Beveridge, K.C.B., LL.D., F.B.A.

Council

R. G. D. Allen.
Sir Percy Ashley, K.B.E., C.B.
M. S. Bartlett, D.Sc.
W. A. Basham, O.B.E.
M. S. Birkett, O.B.E.
Lt.-Col. William Butler, M.B.
*Harry Campion.
A. M. Carr-Saunders.
Iris Douglas.
Sir W. Palin Elderton, C.B.E., F.I.A.
G. W. S. Epps, C.B., C.B.E., F.I.A.
C. O. George, Ph.D.
R. F. George.
*R. G. Glenday, M.C.
Sir Gwilym Gibbon, C.B., D.Sc.

David Heron, D.Sc.
A. Bradford Hill, D.Sc., Ph.D.
J. O. Irwin, Sc.D., D.Sc.
Leon Isserlis, D.Sc.
Professor J. H. Jones.
M. G. Kendall.
*J. M. Keynes, C.B.
*Sir Walter Layton, C.B.E., LL.D.
*Professor E. S. Pearson, D.Sc.
*Professor Arnold Plant.
E. C. Rhodes, D.Sc.
E. C. Snow, C.B.E., D.Sc.
Percy Stocks, M.D.
Sir Sylvanus Vivian, C.B.
John Wishart, D.Sc.

Those marked * were not Members of Council during the preceding Session.

Honorary Treasurer

David Heron, D.Sc.

Honorary Secretaries

E. C. Snow, C.B.E., D.Sc.   Leon Isserlis, D.Sc.

A. Bradford Hill, D.Sc., Ph.D.

Honorary Foreign Secretary

E. C. Snow, C.B.E., D.Sc.

On behalf of the Council,

H. Leak,

President.

E. C. Snow,

L. Isserlis,   }-*Hon. Secretaries.*

A. Bradford Hill }

June 10*th,* 1941.

APPEN

STATEMENT OF INCOME AND EXPENDITURE

EXPENDITURE.

1939.									1940.				
£	*s.*	*d.*	£	*s.*	*d.*		£	*s.*	*d.*	£	*s.*	*d.*
			380	0	0	Rent				380	0	0
			137	1	10	House Expenses				142	13	4
						Salaries and Wages (including						
						contribution to Staff						
			859	3	9	Superannuation Scheme)				783	5	2
			199	5	0	Pension and Allowance ...				189	0	0
						Meetings :—						
96	19	9				Ordinary and General ...	43	17	2			
30	11	7				Research Section	2	0	5			
1	4	3				Study Group	— — —					
			128	15	7					45	17	7
						Publication and Distribution						
						Expenses :—						
764	7	6				Journal and Reprints ...	815	9	3			
190	7	8				Supplement	6	6	10			
			954	15	2					821	16	1
						Library :—						
46	6	6				Books	41	15	2			
100	1	4				Binding	88	2	3			
			146	7	10					129	17	5
			15	0	0	Furniture and Office Equipment				20	9	4
			20	10	3	Insurance				20	16	1
						Stationery and Miscellaneous						
			89	4	4	Printing				64	7	7
			62	3	2	Postage and Telephone ...				58	10	0
			2	15	0	Guy Medal				3	0	0
			25	4	2	Miscellaneous Items				23	13	4
			— — —			Auditor's Fee (1939]				36	15	0
			3,020	6	1					2,720	0	11
						Balance carried to Accumulated						
						Fund : Excess of Income						
						over Expenditure for the						
			241	6	3	year				116	11	8
			3,261	12	4					2,836	12	7
						Amount carried to Life Compo-						
			57	15	0	sition Fund				21	0	0
			£3,319	7	4					2,857	12	7

DIX A.

FOR THE YEAR ENDED 31ST DECEMBER, 1940.

INCOME.

1939.				1940.		
£	s.	d.		£	s.	d.
1,701	0	0	Annual Subscriptions	1,598	2	0
3	10	0	Study Group Subscriptions	—	—	—
11	11	0	Special Subscription and Donation	—	—	—
919	16	8	Sales of Journal and Reprints	695	4	3
16	6	0	Journal Advertisements	15	6	0
119	6	6	Sales of Supplement	34	8	0
2	2	7	Sales of other Publications	2	10	5
50	0	0	Contribution from Royal Economic Society	50	0	0
436	2	2	Dividends and Interest (gross)	441	1	11
1	17	5	Miscellaneous Items	—	—	—

3,261	12	4		2,836	12	7
57	15	0	Life Compositions	21	0	0

£3,319	7	4		£2,857	12	7

APPEN

BALANCE SHEET AT

LIABILITIES.

1939.								1940.					
£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
						Annual Subscriptions received						
			46	4	0	in advance				35	14	0
						Payments for Journal and						
						Supplement received in						
			48	3	1	advance				126	2	7
			139	9	2	Sundry Creditors				206	18	3
						Life Composition Fund :—						
						Balance at December 31st,						
2,163	0	0				1939...	2,220	15	0			
						Add : Life Composition Fees						
57	15	0				received in 1940	21	0	0			
			2,220	15	0					2,241	15	0
						Accumulated Fund of the						
						Society :—						
						Balance at December 31st,						
7,199	19	11				1939, per last Accounts ...	7,441	6	2			
						Add : Excess of Income over						
						Expenditure for the year,						
241	6	3				per annexed Statement ...	116	11	8			
			7,441	6	2					7,557	17	10
			9,895	17	5					10,168	7	8
						Building Fund (per contra) :—						
						Balance at December 31st,						
850	5	8				1939...	883	6	10			
33	1	2				*Add :* Income for year 1940	34	6	6			
			883	6	10					917	13	4
						Frances Wood Memorial Fund						
						(per contra) :—						
						Balance at December 31st,						
356	9	10				1939...	382	3	5			
25	13	7				*Add :* Income for year 1940	23	13	7			
							405	17	0			
						Deduct : Prize awarded ...	30	0	0			
			382	3	5					375	17	0
			£11,161	7	8					£11,461	18	0

Note.—No value is placed in the Accounts on (1) Journals and other Publications in stock, (2) Books in Library, and (3) Pictures, Furniture and Equipment.

DIX B.

31st DECEMBER, 1940.

ASSETS.

1939.								1940.					
£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d
						Investments, at cost or under :—						
						£10,527 12s. 3d. 2½% Consols						
5,580	0	0				(Guy Bequest)	5,580	0	0			
1,185	0	0				£2,236 11s. 3d. 2½% Consols	1,185	0	0			
1,299	0	0				£1,841 3½% Conversion Loan	1,299	0	0			
490	0	0				£500 3½% War Loan ...	490	0	0			
						£1,169 17s. 6d. 3% Local						
800	0	0				Loans Stock	800	0	0			
						£666 4% 2nd Prefd. Stock,						
						London and North-Eastern						
100	0	0				Railway	100	0	0			
						£266 5% Prefd. Ord. Stock,						
						London and North-Eastern						
25	0	0				Railway	25	0	0			
			9,479	0	0					9,479	0	0
						(Market value, December 31st,						
						1940, less Interest accrued,						
						£13,359)						
						Interest accrued on Investments						
			101	19	9	(gross)				101	19	9
			160	5	1	Cash at Bank and in hand ...				199	13	1
						Arrears of Subscriptions re-						
			84	0	0	coverable (estimated) ...				63	0	0
			70	12	7	Sundry Debtors and Payment in						
						Advance				129	14	7
—	—	—				Stock of Journal Paper ...				195	0	0
			9,895	17	5					10,168	7	8
						Building Fund :—						
						£1,006 12s. 10d. 3½% Conver-						
			883	6	10	sion Loan				917	13	4
						(Market value, December 31st,						
						1940, £1,041)						
						Frances Wood Memorial						
						Fund :—						
						£600 4% Preference Stock,						
						London, Midland and Scot-						
300	0	0				tish Railway	300	0	0			
						(Market value, December 31st,						
						1940, £309)						
						Post Office Savings Bank						
82	3	5				Deposit	75	17	0			
			382	3	5					375	17	0
			£11,161	7	8					£11,461	18	0

REPORT OF THE AUDITORS.

We have examined the foregoing Statement of Income and Expenditure and Balance Sheet with the Books and Records of the Society. We have verified the Investments and Cash appearing in the Balance Sheet. We report that the above Balance Sheet is, in our opinion, properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Society, according to the best of our information and the explanations given to us, and as shown by the Books and Records.

PLENDER, *Chartered Accountant.* Auditor.

H. J. BENTLEY ⎱ Honorary
C. OSWALD GEORGE ⎰ Auditors.

PROCEEDINGS OF THE ONE HUNDRED AND SEVENTH ANNUAL
GENERAL MEETING OF THE ROYAL STATISTICAL SOCIETY, HELD
AT THE LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE
ON TUESDAY, JUNE 24TH, 1941.

THE Chair was taken by the PRESIDENT, Mr. H. LEAK, at 5.0 p.m.

The HONORARY SECRETARY read the notice convening the
Meeting, and drew attention to the Report of the Council for the
financial year 1940 and the Session 1940–41, copies of which were
distributed to those present.

The Honorary Secretary announced that in accordance with
Bye-law no. 9 the Council had ordered the names of 22 Fellows to
be erased from the roll of the Society.

A ballot was taken for the election of the President, Council,
and Officers for the Session 1941–42, Dr. J. Kuczynski and Mr.
Fieller being appointed scrutineers. As a result, it was announced
that all those nominated had been elected to the several offices.

The CHAIRMAN moved that the Report of the Council be adopted
and printed in the *Journal*; Mr. BARNARD ELLINGER seconded the
motion, which was then put to the vote and carried unanimously.

A cordial vote of thanks to the President, Honorary Officers and
Council was proposed by Mr. H. C. Craft, seconded by Mr. Fieller,
and carried unanimously.

The Proceedings then terminated.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

CONTENTS

1.—*The Second Yearbook of Research and Statistical Methodology Books and Reviews.* Edited by Oskar Krisen Buros. The Gryphon Press, New Jersey, 1941. $9\frac{1}{4}'' \times 6''$. xx + 383 pp.

Mr. Buros began collecting reviews of books on research and statistical methodology some years ago, and published his work in *Educational, Psychological and Personality Tests of 1936* and in *The 1938 Mental Measurements Handbook.* This new bibliographic material was generally welcomed, and was followed by *Research and Statistical Methodology Books and Reviews of 1933–38.* Gradually enlarging his field, Mr. Buros has now produced the *Second Yearbook,* which is in many ways a great advance on its predecessors. It contains 1652 review excerpts from 283 journals relating to 346 books; the excerpts themselves are longer; and the book is excellently printed. Nor has Mr. Buros yet attained his ideal. If support is forthcoming he proposes to publish similar volumes at one- or two-yearly intervals, and to include reviews in English of foreign books, non-critical abstracts of journal articles and perhaps critical notes on periodical literature as well.

The usefulness to the general reader of having reviews of books which concern him assembled under one cover requires no comment. What will particularly interest both producers and consumers of reviews is Mr. Buros' declaration of the secondary objectives of his compilation :

" To emphasize that there are usually marked differences of opinion even among the more advanced students of statistical theory in their appraisal of a particular book;

" To discourage the writing and publication of stereotyped text-books written by persons ignorant of modern developments in statistical theory;

" To improve the quality of reviews by stimulating editors to take greater pains to choose competent reviewers who have the industry and courage to contribute frankly critical reviews following a careful study of the book being reviewed;

" To improve the quality of book reviews by stimulating reviewers to ' Take their responsibilities more seriously ' by refusing

to review books which they cannot, or will not, appraise competently and honestly."

Now, this gives a reviewer something to think about. Everybody knows that there are a great many bad books on statistics at large in the world. In a recent address Professor Hotelling has explained how many of them come into existence. But this is the first published suggestion I have seen that there is also something wrong with statistical reviewers. It may be worth while examining briefly how far the charges implicitly brought by Mr. Buros will lie.

A glance at the reviews collected in the *Second Yearbook* will be sufficient to establish the point that there is a great deal of variability between reviewers of the same book. Part of the variation is due to the fact that the reviews were written for different journals—readers of the *Lancet*, for instance, expect something rather different from readers of the *Economic Journal,* and certainly get it. If we could analyse the variance between reviewers, we should, I think, find that after eliminating this effect there was a substantial residual, which could be split into two parts : legitimate differences of opinion on contentious matters, and variations according to the reviewers' ability to review.

Apart from matters of presentation and emphasis, the former ought not to be important; but there is distinct evidence that its effect is larger at the present time than it should be. Impartiality is not one of the most prominent statistical virtues. It is not easy to be just to an author who declares, often somewhat dogmatically, that probability is simply relative frequency, when you have spent years declaiming from the house-tops that it is nothing of the kind. It is not easy to give due weight to an author who claims to be able to analyse time-series by regression equations, when you have tried the method in your own particular sphere with negative results. It is very difficult indeed to keep the scales level when the author refers slightingly to work by the reviewer himself. Statisticians, unlike precious odours, are not most virtuous when incensed or crushed, and the fact reveals itself in the reviews they write. I think that perhaps reviewers *could* be a little more objective without loss of critical power.

However, Mr. Buros seems to feel that reviewers are not severe enough, or rather that they suffer from an undesirable diffidence in expressing disapproval. Here, I think, he has a point in relation to current textbooks. In the old days, and in the worlds of art and literature, reviewers and authors said what they thought about each other with devastating candour. (Pope, for example, refers to the swarm of " half-learn'd witlings " who posed as critics in his time, Macaulay insisted on " purging literature from the taint " of Montgomery, and Wagner's comments on the *Blue Danube* are hardly quotable.) Nowadays, in the austerer realms of science, we use the different technique of damning with faint praise. We are mildly encouraging, we are faintly commendatory, we are gently reproving, we are diffidently laudatory, we castigate with the delicate touch of a gardener trying not to brush the bloom off a

bunch of grapes; root-and-branch commination has gone out with the bell, book and candle.

This is perhaps just as well. It is better to give several offenders the benefit of the doubt than to convict one wrongly. But the danger is that we are apt to let indulgence of the author's feelings interfere with our duty to readers of the review. Amid the welter of slightly eupeptic pontification which greets the average text-book nowadays it is almost impossible to discern whether the book is good or bad, and, when this is so, the reviews might just as well not be written.

And this brings us to the second cause of variability: the quality of reviewers themselves, for mild commendation may be due to the timidity of ignorance as much as to the benignity of experience. Perhaps it is not for a reviewer to comment on this subject. Dog does not eat dog, and I for one am not prepared to try to lay down the canons of the recensorial art. But I should like to loose just one broadside against a recognizably distinct type of review which ought never to be permitted by any conscientious editor. It is constructed after the following formula :

(1) Always use the editorial " we " or the third personal form " the reviewer " in making statements of opinion. This gives the review an impressive *ex cathedra* air of authority.

(2) Always find a misprint and point it out. This shows that the reviewer has read the book with complete understanding, and not merely copied his review from the dust-cover or the preface.

(3) Definitely approve or definitely disapprove of the author's treatment of the theory of probability, if any. This is quite safe, and shows that the reviewer is capable of forming an independent judgment.

(4) Always introduce a reference to the analysis of variance. This shows the reviewer to be fully abreast of the current of modern statistical development.

There are other tricks of the trade, but I have said enough to indicate the sort of review I have in mind. Let us at least join with Mr. Buros in suppressing this synthetic abomination.

Coming back to the main point, I feel bound to say that in my humble judgment statistical reviewers in this country do their job reasonably well. There are exceptions, of course, but there are also some masterly pieces of criticism quoted in the *Second Year-book*. Pope, writing of what passed for poetry in his time, con-sidered that the number of bad critics greatly exceeded the number of bad authors :

> " 'Tis hard to say if greater want of skill
> Appear in writing or in judging ill. . . .
> Too few in that, but numbers err in this;
> Ten censure wrong for one who writes amiss."

I should say that, as regards statistical textbooks at the present time, the situation is reversed. Perhaps reviewers are to blame in

not being frank enough.   Perhaps a little invective now and then would be useful.   But shall we not tackle the disease nearer its source, and try to discourage publishers from scrambling into a new market with very poor wares to offer?   M. G. K.

2.—*The Theory and Measurement of Demand.* By Henry Schultz.   University of Chicago Press.   1938. $9\frac{3}{4}'' \times 6\frac{1}{2}''$.   xxviii + 817 pp.

In this work the late Professor Schultz brought together the results of a lifetime of research.   The book is divided into three parts, on the Theoretical Foundations, the Statistical Findings and the Interrelations of Demand.   The first of these, which is prefaced by a short historical introduction, is written mainly from the standpoint of the modern theory of utility, and use is made of the technique of indifference curves.   The subject is clearly presented in simple algebra, and is illustrated with diagrams.   It can be recommended to anyone wishing to understand the essentials of this part of economic theory.

The main factors which emerge from this analysis as being likely to influence the amount of a commodity demanded are the price of that and of all other commodities; the income of the individual or group considered; and general long-run factors which are usually summed up in the symbol t.   Although this is the ordinary method of dealing with factors other than price and income, it is clearly only a first approximation, and has the effect of restricting the analysis to plainly economic factors which can be treated with comparative ease.

The next sections are devoted to an examination of the methods used by other writers to determine demand curves both from time series and from budget data.   These chapters contain a review of the procedures used by Frisch, Leontief, Marschak, Moore, Pigou and Roy.

The second part sets out to determine the demand functions for a number of agricultural commodities.   This demand is, in general, the traders' demand for the product of the farmer, and not the demand of the ultimate consumer.   Such an approach is rendered necessary by the unsatisfactory state of information on retail sales and changes in stocks.   It should also be noted that this section is concerned not with the individual demand function, but with the aggregate demand (of the United States) for the various goods which are analysed.

In this kind of analysis one of the main difficulties is to arrive at adequate formulation of the relationship to be studied.   In his introduction on the problems of statistical technique, Schultz has made it clear that in his opinion there are not really two (or more) relationships corresponding to the two (or more) elementary regressions.   It follows, therefore, that only those equations should be retained for which the correlation coefficients are sufficiently large for the remaining variance to be attributable to inaccuracies in the data, or to the exclusion of unimportant variables which may be supposed to have a remote and random effect.   It is also important

that all variables which, from other analyses, demonstrably influence the dependent variable should be taken into account. If an attempt to do so leads to nonsensical results, it should be possible to explain this by defects either in the data or in the analysis.

This situation is illustrated in the section dealing with sugar. For the period before 1914 it is shown, though Schultz made it clear that the result was altogether unexpected, that the net effect of a rise in incomes was to diminish the consumption of sugar. Such a result seems to run counter to a great deal of evidence on the quantity of sugar consumed at different levels of income, and it seems therefore worthy of a close examination.

The period before 1914 is divided into two; the first from 1875 to 1895, and the second from 1896 to 1914. Consumption is represented by an annual series of home production plus imports minus exports taken per head of the population; the price of sugar is the New York f.o.b. price for fine granulated sugar divided by an index of wholesale prices; income is represented by annual averages of Persons's index of production and trade adjusted for trend and seasonal variation.

It will be noticed that a trendless series is taken to represent income so that only the short-period variations, and not the steady growth of purchasing power, enter the analysis. The latter is left to appear *inter alia* in the trend. Secondly, *faute de mieux* an index of production is taken to represent income. If the analysis were concerned with the demand of the ultimate consumer, it would have been desirable to approach as near as possible to personal incomes rather than any other income concept. In recent times, with the extreme fluctuation of undistributed profits and the stabilizing influence of transfer incomes, it is probable that an index of production would not show the same movements as personal incomes; but in the United States before the last war this difficulty may have been less than at the present day. If, however, the analysis concerns the traders' demand for a commodity, it would be expected that stocks, the current rate of change of prices and expectations of changes in prices and incomes would be relevant to the analysis. None of these factors is introduced, however, doubtless because they cannot be measured for so remote a period. Finally, over the two periods price and income are subject to considerable trend movements in opposite directions, so that price and time are fairly highly correlated, and the trends for each period are so determined that they are unaffected by the other. Over the period 1875–1930 this has the effect that the falling trend of sugar prices jumps up, while the rising trend of consumption drops down at the beginning of each period.

Complications such as these, taken together with the unknown but probably considerable inaccuracy of parts at any rate of the series, render the whole analysis extremely difficult. This difficulty is not surmounted by transforming the variables into their logarithms, changing the expression for the relationship into the form, say, of link relatives or trend ratios, or by taking the different combinations of price, income and time as the determinants of

demand. Furthermore, in cases where there is a high degree of multicollinearity coupled with errors in the independent variables, the usual *t*-test gives a very misleading impression of the accuracy of the regression coefficients.

In a final analysis of the period after the last war covering 1922–36, Schultz succeeds in obtaining a positive coefficient for the regression of the amount of sugar demanded on the short-period variations in income. The same equation, however, yields a negative coefficient of time which Schultz is inclined to attribute to the slimming craze, and possibly also to the substitution of alcoholic beverages for soft drinks. On the other hand, an analysis made by the reviewer for the period 1919–35, with the aid of Kuznets' figures of aggregate income, shows that whether or not these income figures are converted into real terms, the coefficients of both income and time are positive. The fit of these equations is good, the worst years being 1921 and 1922. In the former year prices had been falling precipitately from the boom levels of 1920, and it is not surprising, therefore, that wholesale demand was very much less than the factors, income, price and time would lead one to expect. In 1922, on the other hand, prices had almost ceased to fall, and the previous year had been one in which buying had been light. Again, it is not surprising that purchases were above the level which might be predicted on the basis of the above factors.

The last-mentioned calculations in no way represent a final word; they are intended only to illustrate the sensitivity of the signs, let alone the numerical value of the coefficients, to what may be regarded by some as minor changes in the data.

Facts such as these induce some doubt, at least in the mind of the reviewer, of the finality of some of the coefficients obtained. The equations sometimes seem very simple when it is remembered that the analysis is concerned with demand at the wholesale stage. The data, particularly on income and in the period since the last war, seems unnecessarily approximate. Finally, it is stated in a footnote that the methods of regression analysis associated with the names of Frisch and Koopmans "failed to yield conclusive results". This is an unexpected statement, since intercorrelation of the determining variables is responsible for many difficulties in the regression analysis of economic time series.

The third part of the book contains an interesting theoretical discussion of related demands with some attempts at numerical application. The difficulties in this field are very great.

In addition, the book contains a useful mathematical appendix on the elements of correlation and curve-fitting, a comprehensive bibliography, and indexes classified by author and subject. It covers a wide field and deals clearly with problems of theory and application. It should prove of value and of interest both as a work of reference and as a stimulant to speculation.

The reviewer would like to express his regret for the delay in the appearance of this review. It is due to the new preoccupations imposed upon him by the war. R. S.

3.—*The Taxation of War Wealth.* By J. R. Hicks, U. K. Hicks, and L. Rostas.   Oxford University Press, 1941. $8\frac{3}{4}'' \times 5\frac{3}{4}''$.   x + 304 pp.   12s. 6d.

This book is the result of a grant made in January 1940 by the National Institute of Economic and Social Research for the comparative study of excess profits taxes and capital levies.   For such a study there had long been a need, and it was unfortunate that at a time when the yield would be so valuable the harvesting should be so difficult.   For it is obviously impossible in war-time to garner detailed and complete data from those enemy countries where these types of taxes have been employed, while in friendly countries even the gleaner of statistics is not always welcomed with open arms. And if it is difficult to get helpful facts about past taxes, present experience and experiments are too brief to provide much helpful material.

It is not therefore surprising that the authors have had to rely very largely on secondary sources, but allowing for this and for the many other handicaps with which they have had to labour, they have attained a high degree of success.   One may, perhaps, suggest that in a comparative study there is an optimum degree of detail, which circumstances may sometimes preclude, but that where the treatment is really cursory, as in the case of the British Dominions which together are given only ten pages, such a brief treatment may not be very helpful and may occasionally be somewhat misleading.

But the book as a whole provides a fine example of team work. The team is well chosen and well placed.   Professor Hicks, who opens, deals with the theoretical side and the more general considerations; Mrs. Hicks covers the British excess profits taxes and the proposals for a British capital levy; while Dr. Rostas tackles the capital levies and excess profits taxes of other countries.   Professor Hicks's contribution includes valuable chapters on economic incentive, the significance of war debt, and the case for a supplementary excess income tax, while elsewhere he examines, with characteristic penetration and clarity, other war and post-war problems.   Mrs. Hicks is naturally at home in dealing with British taxes and tax problems.   Making full use of Haig and Stamp, and the Report of the Colwyn Committee, all of which are critically examined, she provides a profound and clear analysis of our past, present, and future problems.   This analysis supports the team's two main recommendations, the first (already adopted) to treat a part of excess profits payments as deferred profits to be conditionally repaid after the war, and, secondly, to impose an excess income tax as a supplement to the excess profits tax.   The idea of a profits suspensory reserve, as the writers point out, is by no means a new idea but was put forward by the Committee on Financial Risks in 1918. (Those interested in this topical question are referred to the relevant extracts from the Committee's Report in Stamp's *Taxation during the War*, Appendix A, pp. 228 *et seq.*)   As for the foreign capital and other taxes, Dr. Rostas has obviously put in a good deal of work in his allotted sphere, and has succeeded in giving us a detailed

yet clear picture of foreign successes and failures. Apart from an occasional tendency to suggest that maximum and optimum tax revenue are synonymous and to accept at their face value governmental declarations concerning the scope or purpose of taxes, his judgment is sound and his analysis illuminating.

The various sections of the work blend well together, and give a satisfying and well-balanced picture of the many theoretical and practical problems involved. There is only one question about which the reader may be left a little puzzled—the influence of a subjective concept of equity as distinct from popular beliefs on the subject. It is not perhaps surprising that such a concept should show many different facets in a book written by three authors. Professor Hicks, while discussing the importance of encouraging economic efficiency in relation to the effective conduct of the war, seems almost on the point of settling the matter once for all. But later on an occasional doubt creeps in whether some subjective, undefined concept of equity may or ought to be considered as of equal importance with the actual effects of taxation. Professor Hicks, however, might be the first to decry such an idea which would apparently leave a wartime government in the dangerous position of the batsman after the luncheon interval who, seeing several balls, did not know which one to hit. Dr. Rostas, although responsible for a new category of " fundamental " equity, is never seriously distracted by the will-o'-the-wisp of a personal equity. Mrs. Hicks, who is eminently practical in all other directions, seems at one point almost to nail down the equity spectre, for when discussing the exemption limit for a capital levy, she declares that " considerations of equity seemed to indicate £1,000 as reasonable." But she does not disclose the process by which this precise figure is divined. Elsewhere she declares that a tax should be considered impracticable if unintentional inequalities between individuals are introduced, and quotes the late Lord Stamp as supporting this view. But such a dictum seems at variance with Stamp's practical attitude, and reference to his quoted work will show that he used the term " grave inequalities " and in a context suggesting he was not concerned with any abstract concept of equality but with something radically different—the practical reactions of the taxpayer.

It is, however, only fair to add that the authors never allow themselves to be seriously diverted from their main task by the varying concept of equity, that chameleon-like spectre which, accompanied sometimes by the even more shadowy figure of social justice, flits across the pages of many tax treatises as an indefinable something of untold potentialities. In all other directions, the work is admirably clear and characterized throughout by its essentially practical treatment, for even in its more theoretical sections, it keeps a close grip on reality. It will thus be an invaluable guide for students and for all interested in present-day finance and the many problems which will arise in the near and more distant future.

<div align="right">C. O. G.</div>

4.—*Price Research in the Steel and Petroleum Industries*. By Committees reporting to the Conference on Price Research. New York : National Bureau of Economic Research. 1939. 9″ × 5½″. 170 pp. $2.

This volume (received in November 1941) is the third of a series containing reports presented to the Conference on Price Research. It consists of two parts, each representing the work of a separate Committee. The first part contains proposals for research on costs, prices, and pricing policies in the American iron and steel industry, while the second part is similarly devoted to the petroleum industry.

The reports have been prepared according to a common plan. Both commence with a survey of those characteristics of the industries studied which are most likely to influence costs and prices, and these introductions furnish some interesting reading in the field of descriptive economics. Detailed consideration is then given to the statistical data available for price study. Much of this material is listed, and is given a broad critical survey in which its definitions, reliability, adequacy, and utility from the research point of view, are considered. Finally, the main research programmes are outlined, and these, in the words of the Committee dealing with the petroleum industry, are " directed toward three broad objectives : Determination of (1) the forces upon which prices and price movements depend; (2) price relationships among the several products of the industry; (3) the functions prices perform and their effectiveness."

The two industries possess many characteristics in common having significance for price and cost determination. In each case there is the relatively high degree of regional concentration, causing transport costs to loom large in the distribution of the products. In production, the costs of both are dominated by the fixed element due to the high proportion of capital sunk in specific assets, the productive contributions of which can only be evaluated in an arbitrary manner. These fixed assets also tend to result in a high degree of inelasticity in supply. In view of the present world conflict, however, there can be no doubt that the most striking feature common to these two industries is their paramount importance in providing equipment for the armed forces of the Allies, and the formulation of systematic research programmes to overcome the difficulties of approach to their study represent very useful pieces of work.

Price data in the iron and steel industry appear to be plentiful, but, unfortunately, the Committee dealing with the subject finds much of it unsatisfactory for scientific purposes. Quoted prices are rarely related to any special specifications of the products, and are merely a starting-point for the calculation of invoice prices. Extras are charged for cutting, annealing, and heat treatment, as well as for such services as speedy deliveries, and, moreover, these charges may be waived in whole or in part in certain circumstances. As these extras and concessions are not separately recorded, quoted prices become merely nominal, and a considerable amount of statistical spadework must be done before adequate price data can be made

available. Cost statistics are also unsatisfactory, since the high degree of integration in the industry serves to conceal much of this information. Common financial interests, together with reciprocal purchases among the firms engaged in the iron and steel and associated industries, may lead to many arrangements which will invalidate existing cost and price data for the purpose of industrial research.

One of the outstanding problems in the oil industry appears to be the determination of the degree of the efficacy of price in regulating the flow of capital into and out of the industry. The element of chance in the discovery of oil, the tendency to operate refineries at full capacity irrespective of market conditions, and the persistent widening of the retail outlet for the principal product, constitute a few of the many forces affecting investment to be examined and assessed. In view of the amount of State regulation of the industry and the taxation imposed on its product, the Committee also emphasize the need for detailed research into the question of elasticity of supply and demand at different price levels as a preliminary step to the study of the effect of these factors upon the industrial structure.

The comprehensive and ambitious programmes laid down by these two Committees involve many tasks which are obviously beyond the powers of any individual research worker to perform. Indeed, the Committee dealing with the iron and steel industry divides its programme into three parts, these being suitable for execution by the Government, by research institutions, and by individuals respectively. Such programmes cannot be undertaken without incurring considerable expenditure of money as well as effort, but neither Committee fails to point out that the benefits of extensive research along the lines indicated, to the industry concerned, to other industries, and to the community generally, should make the undertaking enormously profitable.

<div align="right">T. M. R.</div>

5.—*Methods of Assessing the Physical Fitness of Children.* By Rachel M. Jenss and Susan P. Souther. Washington U.S. Department of Labour, Children's Bureau. 1940. vi + 121 pp. 15 cents.

The purpose of this study is to find an efficient, economical, and simple method of assessing the physical fitness of children. The study was begun in 1934 and concluded in 1939. It was a co-operative enterprise sponsored by the Children's Bureau of the U.S. Department of Labour, two Departments of Yale University, and the municipality of New Haven, Conn. The workers who conducted the enquiry were specially chosen, and exceptionally well trained and experienced. It is therefore disappointing that the conclusions reached do little more than confirm the conclusions of several previous workers : that physical indices do not agree well with clinical assessments, and that the clinical examination itself does not satisfactorily indicate a child's state of nutrition or fitness.

Though the conclusions are familiar the methods employed in the enquiry are interesting and exceptionally thorough. The field observations were made in New Haven on over 700 white boys and

girls. These children were examined twice within 20 months by a pediatrician and an anthropometrist; they were weighed frequently, and their homes were visited by social workers. The authors adopted five criteria of the physical fitness of these children, based on clinical judgments of nutrition and health, and on changes in weight and in arm girth. The weakness of such criteria is recognized, but it is suggested that while the failure of an index to agree with any particular criterion may not prove that the index is inefficient, its failure to show substantial agreement with all five methods justifies the conclusion that the index is not a satisfactory screen for selecting children who need medical attention.

In terms of these criteria four physical indices were tested :—

> (1) The Baldwin Wood Tables showing average weight for age and height;
> (2) The Pryor Tables showing average weight for age and hip width;
> (3) The ACH (Arm Chest Hip) Index, which selects children with abnormally small musculature and subcutaneous tissue;
> (4) The Nutritional Status Indices, devised to reveal deficiencies in musculature, weight or subcutaneous tissue.

The reason given for the selection of these four indices is that they have been more or less widely used during recent years. This is certainly true of the Baldwin Wood and Pryor Tables, but to obtain the Nutritional Status Indices one must take 8 delicate measurements and consult 10 rather complicated tables; the ACH index also requires 5 difficult measurements in addition to several simple calculations. One doubts whether either of these indices has been or can be widely used in routine school practice.

The exhaustive tests devised by the authors show very little agreement between these four indices and any of the five criteria, and compel the conclusion that the indices are probably neither sensitive nor selective methods of assessing physical fitness. On the whole the clinical estimate of the state of nutrition was the criterion with which the indices agreed best, and the highest agreement was that between the clinical estimate and the simplest of the indices— the deviation from average weight for height and age. This confirms the findings of other enquiries.* Dr. Bradford Hill has pointed out, however, that if weight enters into the clinical assessment, then we are bound to get an agreement between the objective and subjective tests. The objective test must tend to pick out the same boys as the subjective test if the latter, unconsciously perhaps, includes the former.

The unsatisfactory performance of the indices compels one to wonder why it is that those who have gone to the trouble of producing and publishing such indices have rarely attempted the vital task of verifying empirically the claims they have made for their indices. For example, in the monograph on Nutritional Status Indices published by the American Child Health Association the authors claim that the index they have devised is " most accurate "

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* *Journ. Roy. Stat. Soc.*, Vol. CI, Part I, 1938, pp. 16–17.

in selecting children who should be seen by a physician; but there is no indication of the evidence on which this claim is based.

An attempt was made by the authors to determine the variability and consistency of the clinical method of assessing nutrition. As in similar enquiries in this field, this essential calibration of a major instrument was not attempted until the rest of the enquiry was complete. It was found that three experienced pediatricians agreed in their assessments of the state of nutrition of only 77 children out of 208, and that Dr. A. (who examined the children in the main enquiry) was consistent concerning only 40 per cent. of the children she assessed as poorly nourished. It is interesting to observe that the superficial stability of assessment found among English School Medical Officers (and which has misled the Board of Education) is found in this study also. The American physician placed about the same *proportion* of children in the various grades of nutrition when she examined them after an interval of about 14 days, but they were not the same children.

After reviewing the inadequacy of clinical examination and indices of body-build, the authors conclude that " some other procedures must be found." They hint at further publications developing a more constructive approach. One wonders whether they have considered the possibility of testing growth as an index of health and fitness. Time Increment Tables, developed by Mr. D. Caradog Jones, were found valuable by Dr. Mumford * at the Manchester Grammar School and by Dr. Friend at Christ's Hospital.† The thorough testing of indices of growth calls for more time and greater resources than the research worker can usually command, but the authors, with their weighty sponsoring, may be able to undertake the task.

It is very much to be hoped that the authors will popularize their important results, and so drive them home that public health administrators, pediatricians, teachers, and others interested in child health will realize that clinical assessment is not a reliable method of determining the fitness or nutritional status of a child, and that the many physical indices tested up to the present are not efficient either.   R. H. J.

* A. A. Mumford, *Healthy Growth*, p. 103 and Appendix I.
† G. E. Friend, *The Schoolboy*, pp. 48–50 and Appendix I.

STATISTICAL NOTES

1. British Official Statistics

The general movement of *wholesale prices* is still a rise, but from month to month it is very gradual. Between August and December 1941, according to the Board of Trade index-number of whole-sale prices, it was only 1¾ per cent. Industrial materials and manufactures increased in price by only 1 per cent., and food and tobacco by about 3·2 per cent. The principal advance in price was that in the cereal group, the index-number for which rose rather more than 11 per cent. The only other group which showed an appreciable advance was that of textiles other than cotton and wool (2 per cent.). Five groups showed advances of less than 1 per cent., three of between 1 and 2 per cent., while there was a slight decline (0·3 per cent.) in the group " meat, fish and eggs." As has been stated in previous issues of the *Journal*, the control by the Government of both prices and supplies in many instances makes the index-number somewhat more difficult of interpretation than in ordinary times. The fact also that articles subsidized by the Government are sometimes sold to consumers at lower prices than those at which they have been purchased adds a further complication.

Over the twelve months since December 1940 the general index-number has advanced 4·9 per cent., the food and tobacco groups showing a rise of 4·2 per cent. and industrial materials and manu-factures 5·3 per cent. The group showing the greatest advance was that of textiles other than cotton and wool (14·7 per cent). Cereals advanced 13·9 per cent., cotton 11·1 per cent., basic materials (ex-cluding fuel) 7·8 per cent., coal and the miscellaneous group 6·9 per cent., and building materials 6·8 per cent. The group for meat, fish and eggs showed a decline of 3·9 per cent., due principally to a decline in the prices of fish and eggs. The non-ferrous metals and iron and steel groups, where practically all prices and supplies are under control, showed advances of 0·6 and 1·2 per cent., respectively.

The following table shows the Board of Trade index-number of wholesale prices for the months August to December 1941, together with the increases at December 1941 over the prices at December 1940 and 1939 and at August 1939.

(Average of prices in 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Inter- mediate Products	Manu- factured Articles	Building Materials
Aug. 1941 ...	145·8	156·8	153·2	168·1	165·8	148·9	140·3
Sept. ,, ...	147·1	157·7	154·3	170·4	166·7	149·1	140·3
Oct. ,, ...	147·7	158·0	154·6	170·9	167·0	149·4	141·0
Nov. ,, ...	148·7	158·3	155·2	171·0	167·5	149·8	141·1
Dec. ,, ...	150·5	158·4	155·9	170·5	167·7	150·3	141·8
Dec. 1940 ...	144·5	150·4	148·6	158·2	160·7	144·3	132·8
,, 1939 ...	118·1	124·3	122·3	135·0	125·0	122·0	110·3
Aug. ,, ...	90·4	102·2	98·1	94·5	104·0	108·7	104·1
Percentage in- crease in Dec. 1941 over— Dec. 1940 ...	4·2	5·3	4·9	7·8	4·4	4·2	6·8
,, 1939 ...	27·4	27·4	27·4	26·3	34·2	23·2	28·6
Aug. ,, ...	66·5	55·0	58·9	80·4	61·3	38·3	36·2

The figures of some other British index-numbers of wholesale prices and the index-numbers of wholesale prices prepared by the United States Bureau of Labor are given below.

Date	Board of Trade (1930 = 100)	Economist (1927 = 100)	Statist (1866–77 = 100)	The Times (1913 = 100)	United States, Bureau of Labor (1926 = 100) [a]
Aug. 1941 ...	153·2	106·4	145·1	171·4	89·8
Sept. ,, ...	154·3	107·1	145·5	171·2	91·3
Oct. ,, ...	154·6	107·2	143·7	171·2	91·5
Nov. ,, ...	155·2	107·4	145·5	171·3	92·0
Dec. ,, ...	155·9	108·5	146·5	171·7	93·1
Dec. 1940 ...	148·6	100·9	131·5	165·2	79·8
,, 1939 ...	122·3	91·7	120·1	142·5	84·3
Aug. ,, ...	98·1	70·3	90·4	114·5	80·5

* Mean of weekly figures.

The course of wholesale prices in the United States since the beginning of the war, as given by their official index-number, has shown an advance (15·6 per cent.) much less steep than the advance in Great Britain (58·9 per cent.), but the comparatively small general advance masks to a considerable extent the rise in the prices of a number of primary products. In the Bank of England's index-number of fifteen similar products in Great Britain and the United States the rise since the beginning of the war has been for the last six months of 1941 higher in the United States than in the United

Kingdom, as will be seen from the subjoined table, giving the index-numbers at certain dates.

Date (week ended)	Articles of Food		Metals		Other Industrial Materials		Total.	
	U.K.	U.S.A.	U.K.	U.S.A.	U.K.	U.S.A.	U.K.	U.S.A.
Aug. 13, 1939 ...	100	100	100	100	100	100	100	100
Dec. 30, ,, ...	124·5	117·2	119·9	109·7	135·6	131·1	126·8	119·5
,, 28, 1940 ...	139·8	117·5	126·1	105·3	132·4	122·4	133·6	115·7
,, 13, 1941 ...	138·8	165·5	126·5	110·9	146·8	153·6	137·9	145·1

Prices of primary products generally were higher in the United Kingdom until the beginning of July 1941, when the index-numbers for the two countries were at the same level (136·2). But since then prices in the United States have advanced more appreciably, and at the end of 1941 the index-number for the United States showed an advance of 45·1 per cent. since the beginning of the war, compared with 37·9 per cent. in the United Kingdom. The difference in the amount of the increase is greatest in articles of food, where American prices have increased 65·5 per cent. and British prices 38·8 per cent. Part of this disparity, but not all, is no doubt due to the control in Great Britain of the prices of meat and certain cereals. On the other hand, metal prices, which are almost entirely controlled in Great Britain, have advanced 26·5 per cent., compared with 10·9 per cent. in the United States. It will be interesting to note what the effect on the index-number will be of the fixation and control of prices in the latter country under the recent legislation.

Since the beginning of September 1941 there has been some slight decline on the whole in the *retail prices* of those articles of food included in the index-number of the cost of living prepared by the Ministry of Labour and National Service. There have been slight increases in the prices of flour and milk, which have been rather more than counterbalanced by the reductions in the prices of bread and potatoes. Over the same four months there has been an increase in the cost of clothing of about 4 per cent., with smaller increases in prices of fuel and of miscellaneous articles of domestic consumption.

The following table gives for the last few months the index-numbers for prices of articles of food and other domestic requirements of working-class families, and are intended to show the average increase in the cost of maintaining unchanged the standard of living prior to August 1914, " *no allowance being made for any changes in*

the standard of living since that date, or for any economies or readjustments in consumption and expenditure since the outbreak of war."

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	Total
July 1914	100	100	100	100	100	100
Sept. 1st, 1941 ...	166	164	380–385	228	230	199
Oct. 1st, ,, ...	165	164	385–390	229	231	199
Nov. 1st, ,, ...	165	164	395	229	231	200
Dec. 1st, ,, ...	165	164	395–400	230	232	201
Dec. 1st, 1940 ...	*173*	*164*	*320*	*219*	*221*	*195*
,, *1939* ...	*157*	*162*	*245*	*195*	*189*	*173*
Sept. 1st, ,, ...	*138*	*162*	*205–210*	*180–185*	*180*	*155*

Since the beginning of the war the index-number for food prices has risen about 19·5 per cent., that for clothing about 90 per cent., that for fuel and light 26 per cent. and that for " other items "* 29 per cent. There has been a rise of about 1·2 per cent. in the cost of rent and rates. The general result is an increase in the cost of living of just on 30 per cent. The large increase in the index-number for clothing is due in part to the purchase tax. The largest advances in food prices have been those of fish, milk, eggs and bacon.

The Agricultural Statistics for 1939 (Part 1) which have recently been published by the Ministry of Agriculture record the utilization of agricultural land and the numbers of live stock in England and Wales on the eve of war. They are in a similar form to those issued in previous years, and contain information relating to the output and prices of agricultural produce in 1939. A summary of the figures relating to the index of agricultural prices and the value of the agricultural output for 1938–39 was given in this *Journal*, Part II, 1941, pp. 187–9.

Agricultural prices continued to rise during 1941. The general index for the year has not yet been published, but the monthly index calculated by the Ministry of Agriculture shows an average figure of 151 for December 1941, as compared with 137 in the preceding January and 112 in January 1940. (Base 1927–29 = 100.) The index for cereals and farm crops taken together rose from 146 in January 1941 to 168 in the following December, while live stock and live-stock products in the same period showed increases from 136 to 148. These figures include allowances for Government

* Soap, soda, domestic ironmongery, brushes, pottery, tobacco and cigarettes, fares and newspapers.

subsidies in respect of wheat, cattle and milk, and are corrected for seasonal variation.

Unemployment continued to decline during the three months from August 11th to November 17th, 1941, and the number of persons on the registers of the Employment Offices of the Ministry of Labour and National Service in Great Britain fell from 270,289 at August 11th to 199,102 at November 17th, a decline of 71,187 since August 1941, and of 1,032,590 since August 1939. Of the latter total 27,821 men and boys were classified by interviewing panels as unsuitable for ordinary industrial employment, 3,076 women and girls were classified as unsuitable for normal full-time employment and 3,311 as unable for just cause to transfer to another area. The total number on the registers (199,102) included 138,229 who were applicants for unemployment benefit or allowances, compared with 191,178 out of a total of 270,289 at August 11th.

The decline in the numbers unemployed during the previous six months has not been very marked, but when allowance has been made for those that are practically unemployable and those unfitted for most employment, the number of workers at the disposal of the Ministry of Labour for suitable placing must be very small. No doubt, also, there must always be a fair number on the registers for a few days only while they are being transferred to new jobs.

The table below shows the number in Great Britain of the insured and uninsured workpeople of 14 years of age and over who were remaining on the registers of the Employment Offices at the dates given.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Aug. 11th, 1941 ...	219,771	37,950	12,568	270,289	143,675	126,614
Sept. 15th, ,, ...	196,594	23,973	10,054	230,621	117,483	113,138
Oct. 13th, ,, ...	185,850	20,452	9,897	216,199	113,074	103,125
Nov. 17th, ,, ...	171,984	16,012	11,106	199,102	112,033	87,069
Nov. 11th, 1940 ...	*603,241*	*163,364*	*24,575*	*791,180*	*428,256*	*362,924*
Aug. 14th, 1939 ...	*968,108*	*211,978*	*51,606*	*1,231,692*	*947,099*	*284,593*

The total number of boys and girls between 14 and 18 on the registers of the Employment Offices in Great Britain of the Ministry of Labour and National Service at November 17th, 1941, was 22,554 (9,249 boys and 13,305 girls). Of these 6,107 girls and 4,273 boys were under the age of 16. Only 398 (261 girls and 137 boys) were

attending authorized courses of instruction, and 268 of these were in Wales.

In the issues of the *Ministry of Labour Gazette* for November and December 1941 are given the results of an inquiry into the *earnings of workpeople* in most of the principal manufacturing industries in Great Britain and Northern Ireland and in some of the principal non-manufacturing industries. The inquiry asked for the numbers and total earnings of men (21 years and over), youths and boys, women (18 years and over), and girls employed in the week ended July 12th, 1941, and was in continuation of similar inquiries relating to the week ended July 20th, 1940, and the last pay-week of October 1938. The earnings of office staffs, shop assistants and outworkers and of salaried workers generally were excluded, but those of foremen, transport workers and warehousemen, etc., unskilled workers and general labourers were included. About 56,600 returns suitable for tabulation were received, covering in all over six million workpeople. The returns have been classified in 16 large groups of trades embracing about 90 different industries. In one group—the metal, engineering and shipbuilding trades—the earnings are shown under 20 different headings. Apparently the earnings of coal-miners and of railway servants were not ascertained.

Taking all the industries included in the returns the average earnings in the week selected—was 75s. 5d. The earnings of the men over 21 averaged 99s. 3d., youths and boys, 40s. 7d., women over 18, 44s. 4d., and girls 25s. 2d.

The trade groups showing the highest earnings were building and contracting 90s. 5d., Government industrial establishments 89s. 5d., and metal engineering and shipbuilding 88s. 8d. The high earnings in the building and contracting group of industries is due, to a considerable extent, to the large earnings of youths and boys, which averaged 50s. 5d., although apparently a large proportion of these are of the semi-skilled or unskilled labour classes.

The group earnings were lowest in the clothing trades (45s. 6d.), textile trades (52s.), food, drink and tobacco trades (60s. 7d.), leather and leather goods industries (62s. 10d.), and pottery, brick and glass trades (64s. 10d.). In most of these trades females either constitute the majority of the workpeople employed or form a large proportion thereof.

Of the trades within the groups, men's earnings were greatest in the motor and aircraft industry (127s. 5d.), followed closely by shipbuilding and ship repairing (116s. 7d.), steel smelting and rolling, etc. (111s. 5d.), the electrical contracting branch of the building, etc., industry (114s. 10d.), and by men in Government industrial

establishments (110s. 10d.). In 22 of the 90 trades for which separate figures are given men's earnings in the week selected averaged 100s. or over, and 15 of these trades were in the metal engineering and shipbuilding group. The lowest earnings of men were in the flax industry (62s. 4d.), small laundries (62s. 5d.), and in jute manufacture (68s. 4d.).

Women's earnings were highest in tramway and omnibus service (61s. 4d.), aircraft manufacture (54s. 9d.), Government industrial establishments (54s.), general engineering (50s. 7d.), and the tobacco trade (49s. 8d.). They were lowest in flax manufacture (28s. 11d.), small laundries (29s. 9d.), and in the toy games and sports requisites manufacture (36s. 7d.).

The highest earnings paid to youths and boys (63s. 1d.) were in the public-works contracting branch of the building industry, but earnings were as high as 50s. 7d. in non-ferrous metal manufacture, 48s. 5d. in aircraft manufacture, and 48s. 4d. in pig-iron manufacture and in the building trade. The lowest earnings were in the flax industry (24s. 7d.), the shirt, collar, etc., manufacture (29s. 7d.), and the printing and book-binding trades (26s. 3d.). In the last-named trade the low earnings are probably due, for the most part, to the existence to a much greater extent than in most trades, of a system of apprenticeship.

The earnings of girls (under 18) were highest in aircraft manufacture (33s. 6d.), in the cotton and woollen trades (29s. 2d.), and in general engineering (29s.). They were lowest in retail bespoke tailoring (18s.), in printing and bookbinding, and in the smaller dressmaking firms (19s. 2d.), in flax manufacture (20s. 2d.), small bread and biscuit, etc., firms (20s. 6d.), and laundries (21s.).

Compared with the similar inquiry in October 1938, there was in July 1940 an increase in earnings of 29·9 per cent., and in July 1941 of 42·4 per cent. The proportional increases and the actual increase in earnings varied considerably as between male and female workers, as will be seen from the following table.

	Average earnings in one week of			Percentage increase between Oct. 1938 and	
	Oct. 1938	July 1940	July 1941	July 1940	July 1941
	s. d.	*s. d.*	*s. d.*	Per cent.	Per cent.
Men (21 years and over) ...	69 0	89 0	99 5	29·0	44·1
Youths and boys	26 1	35 1	41 11	34·5	60·7
Women (18 years and over) ...	32 6	38 11	43 11	19·7	35·1
Girls	18 6	22 4	25 0	20·7	35·1
All workers	53 3	69 2	75 10	29·9	42·4

The figures given in the table on p. 391 are based on the estimated numbers engaged in the industries covered by the returns, and not on the actual numbers of workers employed by the firms making the returns (about 6,000,000 in July 1941). The results from the two methods are, however, in close approximation. It should be noted that the earnings for " all workers " are affected by the fact that there was a greater proportionate number of adult males employed in October 1938 than in July 1940 and July 1941. The proportion in July 1941 must have been considerably less. Moreover, since October 1938 there has been a large number of transfers from non-essential trades to the munitions and other essential industries.

Remarkable changes have been made recently in the *wages of agricultural labourers* in England and Wales. For many years minimum wages were fixed by County Agricultural Committees, which varied from county to county as a consequence of old-standing customs or the prevalence of competitive industries. In many cases there were variations of a shilling or two a week as between adjoining counties for which there seemed to be no obvious reason. In 1940 it was decided to adopt the system of a national minimum wage, while leaving the County Committees free to settle county rates (subject to this minimum) and to regulate other factors, such as hours of work, overtime and extra allowances in accordance with local conditions. The fixing of the national minimum was left to the Central Agricultural Wages Board, and in June 1940 the Board prescribed a rate of 48s. per week for adult male workers. Subsequently, as from the beginning of 1942, this rate was raised to 60s. The extent of the general increase in wages in the last few years may be seen by comparing this national minimum of 60s. with the average rate of 33s. prevailing as recently as 1937, indicating a rise of about 80 per cent.

The hours in respect of which the national minimum is payable vary somewhat locally, but are substantially unchanged from what they were in earlier years—that is to say, in most counties the working period is 50 hours during 8 summer months and 48 hours in the winter, though a proportion of counties have a 52- or 54-hour week. When overtime is worked, the rates vary from 1s. to 1s. 6½d. on week days and from 1s. 2d. to 1s. 10d. on Sundays. Besides the men classed as ordinary workers, there are more skilled workers, such as cowmen, stockmen, shepherds, etc., who normally work longer hours. In about one-third of the counties these men are paid an inclusive rate ranging from 3s. to 15s. above the national minimum. In 1937 the wages of these skilled workers were thought

to average about 40*s.*, so that the increase here is probably about 66–70 per cent. Proportionate wages have also been fixed for younger workers, for women and for workers without agricultural experience, so that all grades of workers have benefited by the national minimum.

The increase in wages is likely to affect the rates paid for cottages so as to bring them more into relation with current values and to encourage expenditure on repairs. Formerly when cottages on farms were occupied by agricultural workers as part of their wages, the employer was only authorized to deduct 3*s.* a week from their wages as rent. The tendency is for this rate to be raised, and also to allow employers to apply for cottages of superior accommodation to be valued at higher rates.

No recent statistics are available as to the number of persons affected by these increases in wages, but the number of workers stated by occupiers of agricultural land to be employed in June 1939 was just over 600,000. These figures included male and female workers of all grades in regular or casual employment, young people of both sexes, and gardeners and labourers employed by market-gardeners and horticulturists.

CURRENT NOTES

THE latest issue of *Sankhyā* (Vol. 5, Part 3, 1941) contains the continuation of the Proceedings of the Indian Statistical Conference of 1940 (Third Session, Madras and Mysore). The three Sections dealt respectively with Population and Vital Statistics; Education and Psychology; Agriculture and Design of Experiments Professor Hotelling was Chairman of all three.

The first Section opened with a paper on the Indian Census, by Mr. M. W. M. Yeatts, the Census Commissioner. He was particularly occupied with the question of utilizing the Census enquiry for the education of the people, thut " improving the system at the bottom " until " every citizen should be a field observer." Instead of relying on the " primitive method of a simultaneous country-wide count," " once we have a sufficient cadre of reliable observers in close and regular contact with phenomena, then we should be able to derive all the information we want from an examination of material regularly produced day by day, month by month, year by year." He emphasized the need for a forward vision, " which looks at the Census not as an activity in itself but as part of the general scheme of administration and information the country needs." Mr. Yeatts emphasized that in India the size of the area

and the numbers of the population " make the simultaneous system a sacrifice to theory," and ended by confessing that his habitual preoccupation was to discover how the Census could be economically used to produce other information than that directly contemplated by its schedule. Professor P. J. Thomas (of Madras University), discussing the Census as an agency for economic planning, pleaded for uniformity in the classification of occupations, and for fuller details about them; for a permanent Census staff and, if possible, for the separate Census of Production and the Economic Census advocated in the Bowley–Robertson Report. The other papers in this Section were Correlation between Anthropometric Characters in some Bengal Castes and Tribes (P. C. Mahalanobis and Mrs. Chameli Bose); the Influence of Seasons on Human Reproduction (N. T. Mathew); a Statistical Analysis of Medical Examination Reports of University Students, Mysore, by K. N. Kamalamma, and an Estimate of the Population of India for the year 1941, by T. and R. S. Krishnamurthy. G. V. Krishnaswami contributed a brief summary of some aspects of the tendency of population in India, as shown by an analysis of the Censuses and of the Reports of the Public Health Commissioner.

The principal paper in the Education and Psychology Section is a Statistical Analysis of Experiments on Differential Limen Values for Lifter Weights by P. C. Mahalanobis and K. R. Nair. Q. M. Hossain contributes an examination of methods of Standardization of Examination Marks; " Are Habits Transmitted ? " is an account by B. Kuppaswamy of an experiment in accustoming rats to dive in a particular pattern for their food (the habit so formed was found *not* to be inherited). The remaining papers are Random Lines—a Statistical Study (A. A. K. Ayangar) and Can there be Factor Analysis of Aesthetic Judgment ? (N. S. N. Sastry).

The Third Section consists of a note by K. R. Nair on the Method of Fitting of Constants for Analysis of Non-orthogonal Data arranged in a Double Classification and another on Symmetrical Block Arrangements by K. Kichen, both based on and continuing the work of Yates. An account follows of the joint meeting of the Conference with the Agricultural Section of the Indian Science Congress, under the Chairmanship of Sir T. Vijayaraghavachari, with which the Proceedings terminated.

The Nankai Institute of Economics, after a second move, from Kunming to Chungking, is carrying on its work with characteristic Chinese imperturbability, and has resumed publication of the *Social and Economic Quarterly*, which, as a note explains, had to be sus-

pended " as a result of difficulties arising from air-raids in the summer and fall of 1940." The issue we have lately received contains parts 1–2 of Vol. XII, and is dated January 1941. There are four main articles.

The first, on " War and Transportation in China," by the late L. G. Ting and R. Q. P. Chin, shows how the deficiency of transport hindered military operations and the removal of supplies, factories and people; practically all the railways were in the regions taken by the Japanese; petrol was short, and though the waterways were utilized, resort was had to intensive use of packs and baskets, carts and rickshaws, carried or drawn by men, women, and animals. The second article, by Chien Yuan Wei, traces the course of the Chinese currency and exchange from July 1937 to July 1940. Then follows a paper on Industrial Co-operation, by a Fellow of this Society, J. B. Tayler, who examines the experience of other countries for the guidance of Chinese co-operation. The fourth paper, " Agricultural Labor in a Chinese Village," by Hsiao Tung Fei, seeks, by studying conditions in one small but on the whole typical locality, to discover if the war-time diversion of man-power to the forces and to factories has caused a real shortage of agricultural production. The conclusion is that, so far, it has not done so, but a movement from the land into factories has begun, and a special kind of planning will eventually be needed to meet the special conditions of Chinese farming. These conditions, as exemplified in the village described, are of much interest, both economic and human. The number includes a useful " brief survey " of recent economic literature dealing with China, a " Note on Prices," and several reviews of books.

The Industrial and Agricultural Research Committee have decided with regret that after this next issue (the second part of volume VII, originally intended to appear in 1940), publication of the Supplement must be suspended, probably for the duration of the war. Nearly all members of the Section who would normally be contributors of papers are now entirely occupied with statistical work for Government departments, and have no time at all for researches of their own. The activities of the Section will be resumed at the earliest possible date.

Fellows will be interested to learn that a brief message from Sir Alfred Flux was received by one of his friends in January. In it he expressed his sorrow at Mr. Macrosty's death, news of which only reached him in October, and sent greetings to his colleagues and friends in the Society.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Annals of Eugenics, October 1941—An investigation of the physical and mental characteristics of a pair of like twins reared apart from infancy (with Plates I–IV, and 1 figure in the text) : *Nora Yates* and *Herbert Brash.* Some applications of the method of minimum χ'^2 : *H. Jeffreys.* The detection of linkage. III. Incomplete parental testing : *D. J. Finney.* The joint distribution of variance ratios based on a common error mean square : *D. J. Finney.* The asymptotic approach to Behren's integral, with further tables for the d test of significance (with 3 figures in the text) : *R. A. Fisher.*

The Banker, November 1941—Anti-inflation technique in America. Scottish Banks in 1940–41.

Bankers' Magazine—
  November 1941—Cost of the war.
  December 1941—The political and financial outlook.

Biometrika, October 1941—Medical statistics from Graunt to Farr : *M. Greenwood.* Fiducial argument and the theory of confidence intervals : *J. Neyman.* Tables of percentage points of the Incomplete Beta Function. Computed by Catherine M. Thompson. Prefatory note : *E. S. Pearson.* Description of the calculation and methods of interpolation : *L. J. Comrie* and *H. O. Hartley.* Table of Lagrangian coefficients for harmonic interpolation in certain tables of percentage points : *L. J. Comrie* and *H. O. Hartley.* Table of percentage points of the χ^2 distribution : *Catherine M. Thompson.*

Eugenics Review, October 1941—A study of heredity in an isolated village community : *J. W. McFeeters.* Family allowances and Eugenics : *F. Lafitte.*

Institute of Bankers, Journal of the, January 1942—Financial control after the war : *Oscar Hobson.* Financial control as an instrument of economic policy : *W. F. Crick.* The several sorts of sterling accounts.

Oxford Institute of Statistics, Bulletin, January 10*th,* 1942—1. Relative wages and earnings in different occupations. 2. Earnings : *A. L. Bowley.* The burden of the war : A. Changes in real income, by *J. L. Nicholson.* B. The burden on wages and other incomes, by *M. Kalecki.* Oil supply in the Indian and Eastern Pacific areas : *S. Moos.*

Public Administration, July–September 1941—Lord Stamp : *Sir William V. Wood.* An economic view of rating reform : *Prof. J. R. Hicks* and *Mrs. U. K. Hicks.*

Sociological Review, January–April 1941—The influence of economic conditions on crime—I : *L. Radzinowicz.*

AFRICA—

> *South African Journal of Economics, June* 1941—Native farm labour in Natal : *R. H. Smith.*

INDIA—

> *Indian Journal of Economics, October* 1941—Trends of dietary habits and analysis of food budgets in working class families of Bihar : *K. Mitra.* The elasticity of reciprocal demand and terms of international trade : *A. K. Dasgupta.*
>
> *Sankhyā, August* 1941—Indian census : *M. W. M. Yeatts.* The census as an agency for economic planning : *P. J. Thomas.* The influence of seasons on human reproduction : *N. T. Mathew.* An estimate of the population of India for the year 1941 : *T. Krishnamurthy* and *R. S. Krishnamurthy.* Standardisation of examination marks : *Q. M. Hossain.* A note of the method of " fitting of constants " for analysis of non-orthogonal data arranged in a double classification : *K. R. Nair.* Symmetrical unequal block arrangements : *K. Kishen.*

UNITED STATES—

> *American Economic Review, September* 1941—Certain problems in the study of costs : *C. Reinold Noyes.* Werner Sombart and transcendentalism : *Leo Rogin.* Service industries and employment : *M. W. Reder.* Pigou's employment and equilibrium : *Paul A. Samuelson.*
>
> *American Statistical Association, Journal of the—*
>> *September* 1941—On sample inspection in the processing of census returns : *W. Edwards Deming* and *Leon Geoffrey.* New features of the 1940 population census : *Leon E. Truesdell.* The use of sampling in the census : *Philip M. Hauser.* A significance test for time series analysis : *W. Allen Wallis* and *Geoffrey H. Moore.* The difference between the Paasche and Laspeyres index-number formulas : *Irving H. Siegel.*
>>
>> *December* 1941—Birth rates and the interwar business cycles : *Virginia L. Galbraith* and *Dorothy S. Thomas.* A sequence of historical random events : Do Jesuits die in three's ? : *J. Solterer.* Relation between seasonal amplitudes and the level of production—An application to the production of steel ingots. Probabilities in logarithmic skewed distributions : *G. R. Davies* and *R. H. Smith.* Linear regression when the standard deviations of arrays are not all equal : *G. A. Baker.* Further notes on the difference between index-number formulas : *Irving H. Siegel.*
>
> *American Statistical Association, Bulletin, September* 1941—The interpretation of tests of significance in relation to " fiducial probability " : *Joseph Berkson.*
>
> *Econometrica, July–October* 1941—Mathematical method in the social sciences : *Irving Fisher.* Capital gains and the valuation of capital and income : *H. Neisser.* An index of urban land rents and house rents in England and Wales, 1845–1913 : *H. W. Singer.* A diagrammatic analysis of the supply of loan funds : *B. Higgins.*

UNITED STATES—*Contd.*

Experimental Education, Journal of, September 1941—A study in the prognosis of musical talent : *Elizabeth Medert Taylor.*

Federal Reserve Bulletin, December 1941—Gold and dollar resources of the United Kingdom.

Harvard Business Review, Autumn Number, 1941—Synthetic rubber : *Frank A. Howard.* Steel to meet our needs : *Walter S. Tower.* Compulsory savings in Great Britain : *Sidney Weintraub.*

Milbank Memorial Fund Quarterly, October 1941—Physical status of young men, 1918–1941 : *George St. J. Perrott.* The dental status and dental needs of young adult males : *Henry Klein.* The regional approach to the study of high fertility : *Rupert B. Vance.*

Monthly Labor Review, October 1941—Production, employment, wages and prices in Douglas-fir timber industry.

Political Economy, Journal of—

August 1941—Silver production in Central Europe, 1450–1618 : *J. U. Nef.* The committee for the Nation : A case history in monetary propaganda : *H. M. Bratter.* The investment company Act of 1940 and its background. I : *Chelcie C. Bosland.*

October 1941—The significance and basic postulates of economic theory : A reply to Professor Knight : *T. W. Hutchinson.* A rejoinder : *Frank H. Knight.* Prices under monopoly and competition : *T. de Scitovszky.* Probability analysis in the theory of demand, net revenue, and price : *A. J. Nichol.*

Quarterly Journal of Economics, November 1941—British monetary policy and the housing boom : (whole number) *Wolfgang F. Stolper.* The impossibility of a theoretical science of economic dynamics : *F. S. C. Northrop.* British war time control of aluminium : *Jules Backman* and *Leo Fishman.* Tariff aspects of a Federal Union : *J. S. de Beers.* The " appropriate bargaining unit " problem : *E. B. McNatt.* The production function for Australian manufacturing : *Grace T. Gunn* and *Paul H. Douglas.*

Review of Economic Statistics, November 1941—Changes in consumption expenditures and defense program : *Elizabeth W. Gilboy.* Long cycles in capital intensity in the French coal mining industry, 1840–1914 : *Robert Marjolin.* Economic fluctuations in Japan, 1868–1893 : *Shigeto Tsuru.*

Social Research—

September 1941—Economic impacts of the war : *A. Feiler.* The task of economic stabilization : *J. Marschak.*

November 1941—Wicksell s two interest rates : *J. Marschak.* Monetary equilibrium and the natural rate of interest : *Hans Neisser.* Industrialization in Palestine : *H. Oppenheimer-Bluhm.*

UNITED STATES—*Contd.*

The Record, June 1941—The family income plan : *Arthur Pedoe.*
The control of disease and death in infancy and childhood :
L. I. Dublin and *M. Spiegelman.*
Wheat Studies of the Food Research Institute—
October 1941—Wheat in national diets : *M. K. Bennett.*
November 1941—Why enrichment of flour ? : *Alonzo E. Taylor.*

CHINA—

Nankai Social and Economic Quarterly, January 1941—Vol. XII,
Nos. 1–2—The Chinese dollar : July 1937 to July 1940 :
Chi-Yuen Wu.

SWITZERLAND—

Zeitschrift für schweizerische Statistik und Volkswirtschaft, 1941—
III—Typen und Engpässe der wirtschaftlichen Zirkulation
und die Konsequenzen der staatlich forcierten Wirtschaft für
die Verwendung der Ersparnisse : *Dr. W. Bäggli.* Monopol
oder monopolistische Konkurrenz ? : *Dr. Adolf Kozlik.* Zur
Frage der Korrelation : *Dr. Edgar Shorer.* Finanzprobleme
der Nachkriegszeit : *Prof. E. Grossmann.*

INTERNATIONAL—

International Labour Review—
October 1941—Wartime labour problems in Australia : *E. R.
Walker.*
November 1941—Social problems and legislation in Brazil :
Dr. R. Paula Lopes.

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part III, 1941, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom

Agriculture and Fisheries, Ministry of. Bulletin No. 37. Ensilage, *H. E. Woodman,* and *Arthur Amos.* London : H.M.S.O., 1941. 9¾″ × 6″. iv + 70 pp. 1s. 3d.

Colonial Office. Labour conditions in West Africa. Report by *Major G. St. J. Orde Browne.* London : H.M.S.O., 1941. 9¾″ × 6″. 149 pp. 2s. 6d.

Community feeding in war time. Second edition. Prepared by Women's voluntary services for civil defence. London : H.M.S.O., 1941. 9¾″ × 6″. iv + 38 pp. 9d.

Labour and National Service, Ministry of
Committee on Skilled Men in the Services. Interim report. London : H.M.S.O., 1941. Cmd. 6307. 9¾″ × 6″. 7 pp. 2d.

Man-power; memorandum on the principal new measures to be introduced by His Majesty's Government in pursuance of their man-power policy. London : H.M.S.O., 1941. Cmd. 6324. 9¾″ × 6″. 4 pp. 1d.

Schedule of reserved occupations. Revision December 1941. London : H.M.S.O., 1941. 7″ × 4¾″. vii + 169 pp. 1s.

Select Committee on National Expenditure, Session 1940–1941. Reports : 18th. 56 pp. 1s. 19th. 6 pp. 1d. 20th. 7 pp. 2d. 21st. 20 pp. 4d. 22nd. 11 pp. 2d. 23rd. 5 pp. 1d. 24th. 7 pp. 2d. 25th. 29 pp. 4d. 26th. 5 pp. 1d. Minutes of the proceedings of the Committee together with an index to the reports. 31 pp. 6d. London : H.M.S.O., 1941. 9¾″ × 6″. 10 parts.

Statement by His Majesty's Government on price stabilization and industrial policy. London : H.M.S.O., 1941. Cmd. 6294. 4 pp. 1d.

Treasury.
Committee on the Calling up of Civil Servants. Interim report. London : H.M.S.O., 1941. 9¾″ × 6″. 6 pp. 2d.

Requisitioning and compensation : report of *Mr. John W. Morris, K.C.,* on the requisitioning of land and buildings and the operation of the Compensation (Defence) Act 1939. London : H.M.S.O., 1941. Cmd. 6313. 9¾″ × 6″. 26 pp. 6d.

Works and Buildings, Ministry of. Expert committee on compensation and betterment. Interim report. London : H.M.S.O., 1941. Cmd. 6291. 9¾″ × 6″. 18 pp. 3d.

Scotland, Department of Health for. Summary report by the Department . . . for the period from 1st January, 1939, to 30th June, 1941. Edinburgh : H.M.S.O., 1941. Cmd. 6308. 9¾″ × 6″. 23 pp. 4d.

(b) British Empire

Union of South Africa—

Office of Census and Statistics. Sixth census of the population . . . enumerated 5th May, 1936. Vol. VI, Religions of the European, Asiatic and coloured population. Pretoria : 1941. 12″ × 9¾″. xi + 123 pp. 7s. 6d.

(c) **Foreign Countries**

Argentina—

Dirección General de Estadistica de la Nación. Estadistica industrial de la Republica Argentina correspondiente al ano 1939 . . . (Informe No. 82). Buenos Aires: 1941. $10\frac{1}{2}'' \times 7\frac{1}{2}''$. 117 pp.

Mexico—

Secretaria de la Economia Nacional. Direccion General de Estadistica. Informes sobre las principales estadisticas Mexicanas. Mexico, D.F.: 1941. $9'' \times 6\frac{3}{4}''$. 174 pp.

United States of America—

Federal Reserve System. Banking studies, by members of the staff, Board of Governors of the Federal Reserve System. Washington, D.C.: 1941. $9'' \times 6''$. x + 496 pp. $1.50.

(d) **International**

International Labour Office—

Studies and reports. Series N. No. 24. International comparisons of food costs, by *Robert Morse Woodbury.* Montreal: 1941. (London: P. S. King). $9\frac{1}{4}'' \times 6''$. iii + 78–[5] pp. 4s.

The international labour code 1939 : a systematic arrangement of the conventions and recommendations adopted by the International Labour Conference, 1919–1939, with appendices embodying other standards of social policy framed by the International Labour Organization, 1919–1939. Montreal: 1941. $10'' \times 7''$. lvi + 920 pp.

II.—AUTHORS AND MISCELLANEOUS

Aslett (E. A.), P. D'Arcy Hart, W. J. Martin and *W. T. Russell.* Physical type in pneumoconiosis. Reprint from the *Journal of Hygiene.* XLI, 1941, pp. 169–79. (From the authors.)

Astbury (S. J.). Petroleum statistics. (Reprinted from *Petroleum Technology,* Vol. 6, 1941, pp. 257–74.) $9'' \times 6''$. (From the author.)

Belshaw (H.). Standards of living, wages and prices. Wellington, N.Z.: Modern Books, 1941. (London: Fabian Bookshop.) $8\frac{1}{2}'' \times 5\frac{1}{4}''$. 47 pp. 1s. 6d.

Brown (William Adams). The international gold standard reinterpreted, 1914–34. (Publications of the National Bureau of Economic Research, No. 37.) New York: 1940. $9'' \times 6''$. 2 vols. $12.

Consett (M. W. W. P.). The triumph of unarmed forces (1914–18): an account of the transactions by which Germany during the Great War was able to obtain supplies prior to her collapse under pressure of economic forces. London: Williams & Norgate, 1923. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. xxiv + 344 pp.

Czechoslovak Research Institute. Bulletin of the Czechoslovak Medical Association in Great Britain, No. 1. London: 1941. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. 28 pp.

Dublin (Louis I.) and *Mortimer Spiegelman.* The control of disease and death in infancy and childhood. Reprinted from *The Record, American Institute of Actuaries,* vol. XXX, 1941, pp. 28–57. $8\frac{1}{2}'' \times 5\frac{3}{4}''$. (From the authors.)

Hohman (Helen Fisher). Old age in Sweden: a program of social security. Washington, D.C.: Federal Security Agency, 1940. $9'' \times 6''$. xiii + [2]+305 pp. 35 c.

Institute of Petroleum. Annual reviews of petroleum technology. Vol. 6 (covering 1940). *F. H. Garner, general editor.* Birmingham: Institute of Petroleum, 1941. $9'' \times 6''$. iv + 318 pp. 11s.

II.—AUTHORS AND MISCELLANEOUS—*Contd.*

National Bureau of Economic Research. Price research in the steel and petroleum industries. Prepared for the Conference on Price Research. (Price Studies No. 3.) New York : 1939. $9\frac{1}{4}'' \times 5\frac{3}{4}''$. xiii + 170 pp. $2.

Peller (Sigismund). Malignant melanoma cutis. Reprinted from *Cancer Research*, I, 1941, pp. 538–42.

—— Metachronous multiple malignancies in 5,876 cancer patients. Reprinted from *American Journal of Hygiene*, Vol. 34, No. 1, Sec. A, pp. 1–11. $10'' \times 7''$. (From the author.)

Schröder & Co. (J. Henry). Quarterly review. April 1924–July 26, 1939. London. $12\frac{3}{4}'' \times 8''$. 61 parts.

Schröder Banking Corporation (J. Henry). Finance and trade commentary. May 1927–Feb. 1930. New York. $11'' \times 8''$. 34 parts. (From Mr. S. Chapman.)

Seed (H. E.). The excess profits tax. First supplement to the second edition explaining the excess profits tax provisions of the Finance Act, 1941. London : Gee & Co., 1941. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. v + 34 pp. 5*s.*

Sturzenegger (E.). The Rand gold mines. 11th annual edition, 1941. London : E. Sturzenegger, 28 Bishopsgate, E.C. 2, 1941. $6\frac{1}{2}'' \times 4\frac{1}{4}''$. 263 pp. 25*s.* (including monthly supplements).

Verband Schweiz. Konsumvereine (V. S. K.) Basel. Die Haushaltungsrechnung. Wirtschaftsstatistisches Bureau des V.S.K. (Genossenschaftliche Volksbibliothek, Heft Nr. 48.) Basel : 1941. $9'' \times 6''$. 112 pp. *Fr.* 2.50.

Wallis (W. Allen) and *Geoffrey H. Moore.* A significance test for time series and other ordered observations. (Technical Paper, 1.) New York : National Bureau of Economic Research, 1941. $11\frac{3}{4}'' \times 7\frac{1}{2}''$. xii + 59 pp. 50*c.*

Wickizer (V. D.) and *M. K. Bennett.* The rice economy of monsoon Asia. (Grain Economics Series No. 3.) California : Stanford University, Food Research Institute, 1941. $8\frac{1}{2}'' \times 5\frac{3}{4}''$. xii + 358 pp. $3.50.

Wilson (Sir Arnold) and *Hermann Levy.* Workmen's compensation . . . Volume II, The need for reform. Oxford University Press, 1941. $9\frac{1}{2}'' \times 6\frac{1}{4}''$. xii + 383 pp. 18*s.*

Wyatt (T. W.) and *D. Caradog Jones.* Britain's " new order " : a plea for a sane post-war employment policy. . . . Birkenhead : John Woolman, 1941. $7\frac{1}{4}'' \times 4\frac{3}{4}''$. 31 pp. 9*d.*

PERIODICALS RECEIVED BY THE LIBRARY

ANNUAL LIST

In addition to the publications named in the bi-monthly lists, the Society has received during the past year the official and other periodicals enumerated below.

(a) United Kingdom and its several Divisions

National

United Kingdom—

Admiralty. Navy appropriation account.

Agriculture and Fisheries, Ministry of. Agricultural statistics. Journal of the Ministry of Agriculture.

Colonial Office. Economic survey of the Colonial Empire.

Crown Lands, Office of Commissioners of. Report.

Education, Board of. Memorandum on the Board of Education estimates.

General Register Office. Registrar-General's weekly return of births and deaths. Quarterly return of births, deaths and marriages.

Health, Ministry of. National Health Insurance Fund Accounts.

Home Office. Aliens (naturalization) return. Annual report of the Chief Inspector of Factories. Racecourse Betting Control Board, annual report and accounts.

India Office. Statistical abstract for British India. Return of the budget of the Governor-General of India in Council.

Labour, Ministry of. Ministry of Labour gazette.

Medical Research Council. Bulletin of war medicine.

National Debt Commissioners. Irish land purchase fund, accounts. Local loans fund, accounts.

Parliament. The public general acts and the Church Assembly measures.

Stationery Office. Government publications, consolidated list.

Trade, Board of. Annual statement of the trade of the United Kingdom. Board of Trade journal. Statistical abstract for the British Empire. Statistical abstract for the United Kingdom.

Treasury. Civil estimates. Finance accounts. Financial statement. National debt. Public income and expenditure.

Municipal and other local returns

BIRMINGHAM : *Financial statement.* IPSWICH : Abstract of accounts. ISLINGTON : Abstract of accounts. LEICESTER : Abstract of accounts. LIVERPOOL : Report on the health of the City. SOUTHGATE : Abstract of accounts.

Scotland—

Agriculture, Department of. Agricultural statistics. Scottish Journal of Agriculture.

Health, Department of. Summary report.

Registrar-General. Births, deaths and marriages [weekly and quarterly returns].

EDINBURGH. Abstract of accounts.

GLASGOW. Report of the Medical Officer of Health.

Northern Ireland—

General Register Office. Registrar-General's annual report. Quarterly return of births, deaths and marriages.

(a) United Kingdom and its several Divisions—*Contd.*

Miscellaneous Publications

Accountant. Accountants' magazine. Agricultural Economics Society, Journal of proceedings. Alliance news. Alliance year-book and temperance reformers' handbook. Anglo-Swedish review. Annals of eugenics. Auctioneers' and Estate Agents' Institute, Journal.

Banker. Bankers' almanac and year-book. Bankers' Clearing House, annual statement. Bankers' magazine. Bank of England, statistical summary. Barclay's Bank, Report of Ordinary General Meeting. Belfast, Queen's University calendar. Biometrika. Brewers' almanack and wine and spirit trade annual. British Association for the Advancement of Science, quarterly. British Library of Political and Economic Science annual report. Broomhall's corn trade year-book. Building industries survey. Building societies year-book.

Cambridge University abstract of dissertations. Chamber of Commerce journal. Chartered Surveyors' Institution, journal. Colliery Guardian. Co-operative Union Ltd., Report of the annual co-operative congress. Corporation of Foreign Bondholders, annual report.

Dalgety's annual wool review.

East India Association journal. Economic journal. Economica. Economist. Eugenics review.

Fabian Society : Fabian news. Fabian quarterly, Research series. Tra⟨ series. Faculty of Actuaries, Transactions, Year-book. Financial revie⟨ of reviews. Fireman.

Geographical journal.

Health and empire. Hospitals year-book.

Imperial Institute, Annual report. Incorporated Association of Rating and Valuation Officers : journal. Institute of Actuaries, Journal, Year-book. Institute of Bankers, journal. Institute of Petroleum : Annual reviews of petroleum technology. Institution of Civil Engineers, journal. Insurance directory and year-book. International Federation of Trade Unions, Bulletin. International Rubber Regulation Committee, Statistical bulletin. International Sugar Council, Statistical bulletin. Iron and Steel Institute, journal.

King Edward's Hospital Fund : Annual report, Statistical summary.

Land and liberty. London and Cambridge Economic Service : Bulletin. London Passenger Transport Board, Report and accounts.

Mallett and Co., Weekly wool chart. Manchester school. Manchester Statistical Society, Transactions. Manchester University calendar. Municipal year-book.

National Association for Prevention of Tuberculosis : Report of Council. National Institute of Economic and Social Research, Diary. Nature.

Oxford Institute of Statistics : Annual Report; Bulletin; Oxford economic papers.

Peabody Donation Fund, Annual report of Governors. People's year-book. Planning. Post magazine. Public administration. Publishers' circular.

Quarterly journal of mathematics. Quin's metal handbook and statistics.

Rates levied on various towns. Registered accountant. Registered Accountants' year book. Review of economic studies. Royal Agricultural Society of England, Journal. Royal College of Surgeons of England, Calendar. Royal Institution, Proceedings. Royal Meteorological Society, Journal. Royal Sanitary Institute, Journal. Royal Society of Arts, Journal. Royal Society of Edinburgh, Proceedings, Transactions.

Samuel Montagu and Co., Monthly letter—Annual bullion review. Scottish Chartered Accountants, official directory. Secretary. Seyd (R.E.), statistics of failures. Signal. Society of Incorporated Accountants and Auditors, year book. Sociological review. Statesman's year book. Statist.

Tattersall's cotton trade review (Dec. issue). Taxation. Times. Time literary supplement. Times trade and engineering. Tin.

United empire.

Vacher's parliamentary companion.

Whitaker's almanack. Willing's press guide. Who's who.

(b) **British Empire**

Australia—

Bureau of Census and Statistics. Demography. Finance. Monthly review of business statistics. Official year-book. Pocket compendium of Australian statistics. Press notices. Production. Quarterly summary of Australian statistics. Transport and communication.
Commonwealth Department of Health. Health.
Commonwealth Grants Commission. Report.
Commonwealth Bank of Australia. Statistical bulletin.
Economic record.

NEW SOUTH WALES—

Bureau of Statistics and Economics. Official year book of New South Wales. Statistical bulletin. Statistical register.
Department of Railways. Report of the Commissioner for railways.
Industrial Register. Trade unions.
Parliament. Report of the Auditor-General. Trade Unions: report of the Registrar.

QUEENSLAND—

Government Statistician's Office. Agricultural and dairying production. Live stock and pastoral production. Queensland year-book. Statistics of the State of Queensland.

SOUTH AUSTRALIA—

Statistical Office. Statesman's pocket year-book. Statistical register.

TASMANIA—

Bureau of Census and Statistics, Tasmania Branch. Pocket year book of Tasmania. Statistics of the State of Tasmania.

VICTORIA—

Office of the Government Statist. Victorian year-book. Annual report on friendly societies.

WESTERN AUSTRALIA—

Government Statistician's Department. Pocket year-book. Quarterly statistical abstract. Statistical register.

Canada—

Department of Agriculture. Report of the Veterinary Director-General.
Department of Finance. Public accounts.
Department of Justice. Annual report of the Superintendent of Penitentiaries.
Department of Labour. Labour gazette. Prices in Canada and other countries. Wages and hours of labour.
Department of Public Works. Report of the Minister of Public Works.
Dominion Bureau of Statistics.
  External Trade Branch. Trade of Canada.
  Fisheries and Animal Products Branch. Fishery statistics. Statistics of Dairy Factories.
  General Statistics Branch. Canada year book. Monthly review of business statistics.
  General Manufactures Branch. Manufacturing industries of Canada: summary report. Textile industries of Canada.
  Mining, Metallurgical and Chemical Branch. Annual report on the mineral production of Canada. Coal statistics for Canada. Manufactures of non-ferrous metals in Canada. Manufactures of non-metallic minerals in Canada.
  Vital Statistics Branch. Vital Statistics.

ALBERTA. *Department of Agriculture.* Annual report.
Department of Public Health. Annual report of the Vital Statistics Branch.
ONTARIO (PROVINCE). *Department of Agriculture.* Annual report of the Statistics Branch. Monthly crop report. Monthly dairy report. Report of the Minister of Agriculture.

(b) British Empire—*Contd.*

Canada—*Contd.*

QUEBEC (PROVINCE). Statistical year-book.
Bank of Canada, statistical summary.
Bank of Nova Scotia, Monthly review.
Canadian Bank of Commerce, Monthly commercial letter; annual statement.
Royal Bank of Canada, Monthly letters.

Ceylon—

Administrative reports. Ceylon sessional papers. Minutes of the State Council.

Éire—

Currency Commission. Quarterly statistical bulletin.
Department of Industry and Commerce. Irish trade journal and statistical bulletin. Statistical abstract.
Department of Local Government and Public Health. Annual report of the Registrar-General. Quarterly return of the marriages, births and deaths.
Agricultural Credit Corporation, Ltd., Report and accounts.
Industrial Credit Co., Ltd., Report and accounts.
Irish Agricultural Organization Society Ltd. Report.
Statistical and Social Inquiry Society of Ireland, journal.

Federated Malay States—

Government gazette; Return of imports, exports and re-exports.

India—

Department of Commercial Intelligence and Statistics. Agricultural statistics. Monthly statistics of cotton spinning and weaving. Monthly statistics of production in certain selected industries. Sea-borne trade, annual statement of. Sea-borne trade and navigation [monthly]. Sea-borne trade and navigation for the calendar year. Statistical abstract for British India. Statistical tables relating to banks. Trade at stations adjacent to the land frontier routes.
Department of Labour. Annual report of Chief Inspector of Mines.
Meteorological Office. Memoirs. Scientific notes.
Statistical Research Branch. Review of the trade of India.
ASSAM. Report on the administration of Assam.
BENGAL. Report on the maritime trade of Bengal.
BOMBAY. Labour gazette.
PUNJAB. Memoirs of the Irrigation Research Institute. Report on the public health administration.
All India Institute of Hygiene and Public Health. Annual report.
Indian journal of economics.
Karachi cotton annual.
Sankhyā, Indian journal of statistics.

Jamaica—

Annual report of the Registrar-General's Department.

Malaya—

Department of Statistics, S.S. and F.M.S. Average prices, declared trade values, exchange and currency. Foreign trade of Malaya for the year. Malayan statistics [monthly]. Rubber statistics handbook.

New Zealand—

Census and Statistics Department. Agricultural and pastoral production. Factory and building production. Friendly societies and trades unions. Insurance statistics. Justice statistics. Local authorities' handbook. Monthly abstract of statistics. New Zealand official year-book. Population and buildings. Statistical report on prices, wages . . . banking, building societies, commercial afforestation, incomes and income tax. Trade and shipping. Vital statistics.

(b) **British Empire**—*Contd.*

New Zealand—*Contd.*

Auckland Chamber of Commerce. The Commerce journal.
Canterbury Chamber of Commerce, Bulletin.
Royal Society of New Zealand, Transactions and proceedings.
Wellington Harbour Board, statement of accounts.

Nigeria—

Comptroller of Customs. Nigeria trade summary.

Palestine—

Department of Migration. Statistics of migration and naturalization.
Office of Statistics. General monthly bulletin of current statistics. Statistical Abstract of Palestine. Statistics of imports, exports and shipping.

Southern Rhodesia—

Department of Statistics. Economic and statistical bulletin.
Chamber of Mines of Rhodesia : annual report, monthly returns.

Union of South Africa—

Department of Customs and Excise. Annual statement of the trade and shipping.
Department of Mines. Annual report of the Government Mining Engineer.
Office of Census and Statistics. Census of industrial establishments. Official year-book. Report on agricultural and pastoral production. Report on the statistics of crime. Report on the vital statistics.
CAPE OF GOOD HOPE. Ordinances.
South African journal of economics.
Transvaal Chamber of Mines : annual report, Monthly analysis of gold production.

(c) **Foreign Countries**

Argentine Republic—

Banco Central de la Republica Argentina. Annual report.
Dirección General de Estadística. Anuario del comercio exterior. El comercio exterior Argentino. Informe : el comercio exterior Argentino, Estadística industrial, La poblacion y el movimiento demografico.
Banco Central de la Republica Argentina, Annual report; Revista.
Revista de economia y estadistica.

Brazil—

Banco do Brasil. Relatório do Banco do Brasil . . .
Instituto Nacional de Estatistica. Revista Brasileiro de estatistica.
Ministerio de Trabalho Industria e Commercio. Boletim.
Serviço de Estatistica Economica e Financeira. Comercio exterior do Brasil . . . resumo por mercadorias. Comercio exterior, boletim mensal. Estatisticas econômicas (publ. semestral). Rivista de economica e estatistica. Movimento bancario. Movimento maritimo. Quadros estatisticos (resumo anual de estatisticas econômicas).
Serviço de Informacão Agricola. Boletim do Ministerio do Agricultura.

China—

Maritime Customs. List of lighthouses, light-vessels, etc. Monthly returns of the foreign trade. Trade of China [annual].
Chinese statistical and economic review. Nankai social and economic quarterly.

(c) **Foreign Countries**—*Contd.*

Egypt—

Département de la Statistique Générale. Annuaire statistique. Annual statement of foreign trade. Monthly bulletin of agricultural and economic statistics. Return of shipping, cargo, and passenger traffic in the Egyptian ports and Suez Canal transits [annual, and quarterly]. Statistique des sociétés anonymes par actions. Statistique scolaire. Vital statistics. Weekly return of births, deaths, and infectious diseases.

Finland

Ministère des Affaires Sociales. Revue sociale.

Greece—

Statistique Générale. Annuaire statistique. Bulletin mensuel du commerce special.

Iceland—

Bureau de Statistique. Statistique de l'Islande [including annual reports on agriculture, fisheries, trade, etc.].

Japan—

Japan Institute for Science of Labour. Annual report of the Director.
Kyoto University. Economic review.
Nippon Life Assurance Co. Annual report and statement of accounts.
Oriental economist.
Report on progress in Manchuria.

Mexico—

Dirección General de Estadistica. Revista de estadistica.

Mozambique—

Repartição de Estatistica. Anuário estatistico. Bulletin trimestriel de statistique. Estatistica do comércio e navegação.

Peru—

Departamento de Estadistica General de Aduanas. Anuario del comercio exterior. Boletin de la Superintencia General de Aduanas.
Dirección Nacional de Estadistica. Extracto estadistico.
Banco Central de Reserva, Boletin. Memoria.

Philippine Islands—

Bulletin of Philippine statistics.

Portugal—

Instituto Nacional de Estatistica. Anuário demográfico. Anuário estatistico. Anuário estatistico das contribuições e impostos. Boletim mensal. comércio externo. Estatistica judiciaria. Situação bancaria.

Rumania—

Ministère des Finances. Comertul exterior al României.

Spain—

Dirección General de Estadistica. Boletin de estadistica.

Spanish Morocco—

Inspección de Aduanas. Estadistica del comercio en la zona de Protectorad Español.

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(c) **Foreign Countries**—*Contd.*

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Sweden—

Kommerskollegium. Kommersiella meddelanden.
Riksgäldskontoret. Svenska statens tillgångar och schulder.
Socialstyrelsen. Sociala meddelanden.
Statistika Centralbyrån. Statistisk årsbok. Statistiska meddelanden [including Järnvägsstatistiska medelanden. Uppgifter om bankerna].
    Sveriges officiella statistik [including annual returns relating to agriculture and live-stock, assurance, banking, co-operative societies, crime, excise, finance (state and municipal), fisheries, forests, industry, labour and wages, lunacy, mines, pensions, poor relief, population, postal services, public health, health of army and navy, railways, savings banks. trade and shipping, veterinary service, water-power, etc.].
Sveriges Riksbank. Årsbok.
Skandinaviska Banken, Quarterly review.
Svenska Handelsbanken : Annual report, Index.
Swedish economic review.

Switzerland—

Bureau Fédéral de Statistique. Statistiques de la Suisse [including annual returns relating to : agricultural statistics, assurance societies, crime, finance, forestry, live-stock, vital statistics].
ZÜRICH. Statistisches Jahrbuch der Stadt Zürich. Zürcher statistische Nachrichten.
Journal de statistique et revue économique suisse.
Union suisse du Commerce et de l'Industrie, Rapport sur le commerce et l'industrie de la Suisse.

Turkey—

Office Central de Statistique. Annuaire statistique.

United States—

Agriculture, Department of. Agricultural statistics. Crops and markets. Year-book.
Census, Bureau of the. Cotton production. Cotton production and distribution. Monthly summary of foreign commerce of the United States. Statistical abstract of the United States.
Children's Bureau. Bureau publications. The child: monthly bulletin. Report of the Chief of the Children's Bureau. Social statistics.
Currency, Comptroller of the. Annual report.
Education, Office of. Annual Report of the United States Commissioner of Education. Biennial survey of education. Bulletin. School life.
Federal Reserve System. Annual report of the Board of Governors. Federal Reserve bulletin.
Foreign and Domestic Commerce, Bureau of. Foreign commerce and navigation for the calendar year. Foreign commerce weekly. Survey of current business.
Internal Revenue, Bureau of. Annual report of the Commissioner. Statistics of income.
Labor Statistics, Bureau of. Monthly labor review.
Mines, Bureau of. Minerals year-book.
Panama Canal, Office of the. Annual report of the Governor.
Treasury. Annual report of the Secretary of the Treasury on the state of the finances. Annual report of the Director of the Mint.
Women's Bureau. Bulletin.
CONNECTICUT. Registration report. Report of the State Department of Health. Connecticut health bulletin.
HARTFORD (Conn.). Report of the Public Welfare Commission.
MARYLAND. Annual report of State Board of Health.
NEW YORK STATE. *State Department of Health.* Monthly vital statistics review.
    State Tax Commission. Annual report. New York State tax bulletin.

(c) **Foreign Countries—***Contd.*

United States—*Contd.*

NEW YORK CITY.   New York Public Library, bulletin.

Actuarial Society of America, Transactions.   American Academy of Political and Social Science, Annals.   American economic review.   American Institute of Actuaries : The Record, Year-book.   American Petroleum Institute, Statistical bulletin.   American Philosophical Society :   Memoirs, Proceedings, Transactions, Year-book.   American Statistical Association Bulletin, Journal.   Annals of mathematical statistics.

Carnegie Endowment for International Peace, Year-book.

Chicago Board of Trade, Annual report.

Econometrica.

Harvard business review.

Illinois University Bureau of Business Research, Bulletins.   International conciliation.

Johns Hopkins University School of Hygiene, Collected papers from the Department of Biology.   Journal of calendar reform.   Journal of experimental education.   Journal of political economy.

Mathematical reviews.   Metropolitan Life Insurance Co., Statistical bulletin.   Milbank Memorial Fund : Annual report, Collected papers on research, Quarterly bulletin.   Mineral industry.

Quarterly journal of economics.

Review of economic statistics.

Smithsonian Institution : Annual report, Smithsonian miscellaneous publications.   Social research.   Stanford University Food Research Institute, Wheat studies.

Uruguay—

Contaduria General de la Nacion.   Boletin de hacienda.

(d) **International.**

Bank for International Settlements—

Annual report.   Statement of account [monthly].

International Labour Office—

International labour review.   Studies and reports.   Year-book of labour statistics.

League of Nations—

Economic and Financial Section.   Monthly bulletin of statistics.   Statistical year-book of the League of Nations.   World economic survey.

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